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Contractors and Engineers Monthly

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Dams

Grading

Lubrication

Paving

PWA Work

Work Goes on Night and Day at Norris Dam

The Lubrication of Pneumatic Equipment

1934 Bay State Project Along Paul Revere's Route

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Work Goes On Night and Day

at Norris Dam

CONTRACTORS are watching with interest the work already started at Norris Dam on the Clinch River in Northwestern Tennessee by the Tennessee Valley Authority. A contract was awarded for the speedy construction of the heavy-duty 4½-mile concrete road from Coal Creek to the dam site, but it was decided to build the dam and power house by force account. An effective grouping of construction equipment under the guidance of experienced construction men is producing interesting results. In this article we shall trace the making of the aggregate and the batching and placing of the concrete in the dam. Each has provided very real problems which have been solved by careful planning.

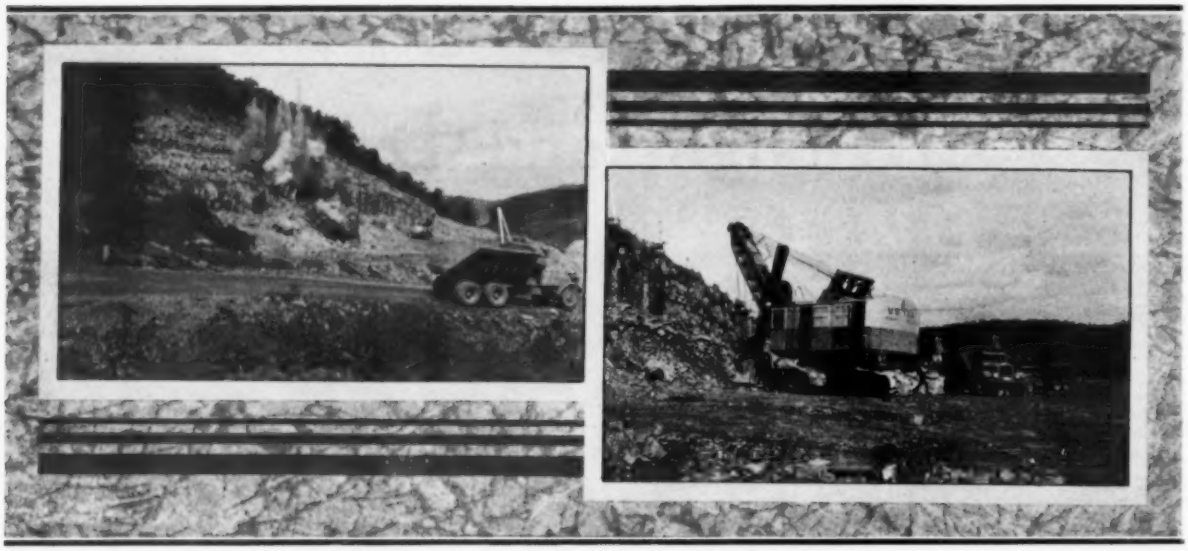
Norris Dam

Norris Dam will be 1,800 feet long, 210 feet thick at the base, 212 feet high to the crest of the spillway. It will cost, with the 83-square mile reservoir, a total of $35,000,000 and will be completed in 1936. One reason for particular care on the part of the engineers responsible for this work is that the area in which the dam is located is a limestone district and other dams which have been built on similar rock formations have shown serious leakage. This eventuality was taken care of by an elaborate grouting procedure for the foundation of the dam before any concrete was placed. The present article deals only with the work now under way in the creation of the dam and the aggregates which go into its construction.

The Quarry

On the west side of the Clinch River a small draw leads down to the river between the dam site and the mouth of Cove Creek. The north hillside of this valley is entirely of dolomite rock overlaid with a slight overburden of earth. This was selected as the source of the coarse aggregate as well as the fine aggregate for the concrete for the entire work. A total of 2,000,000 tons of crushed rock will be needed for the dam and power house. The use of this ledge eliminated the need of building a railroad from Coal Creek to the job and further, the manufacture of sand from the stone available is being done at a cost considerably below the $1 per ton would have been the charge from the nearest commercial sources.

The overburden from the quarry face was sluiced by hydraulic methods using three centrifugal pumps in series, one at the river bank and the others at the quarry floor level, which delivered water to the hydraulic giants at 100 pounds pressure. The water was pumped a total distance of 1,200 feet and to levels more than 240 feet



A Big Blast—and a Big Shovel in the Norris Dam Quarry

above the river. In order to reduce the deposit of silt in the Clinch River from the hydraulic operations, a low wood dam was built in the draw to form a settling reservoir for the sediment.

A total of sixteen wagon drills, including Ingersoll-Rand, Worthington and Gardner-Denver units, are used to drill the face of the quarry at the rate of 16 to 20 feet per hour, depending on the depth of the hole, to maximum depths of 28 feet which is the height of the benches decided upon as most economical. The steel used is 1¼ inches in diameter. Most of the benches are drilled two holes in depth spaced 6 feet each way. This same battery of wagon drills was used on general drilling for excavation on the dam site and, at the very start of the work, for drilling exploration holes for grouting on 10-foot centers and sometimes as close as 5-foot centers. These were washed out and grouted over the entire bottom of the dam site to prevent seepage.

Secondary drilling in the quarry, when the stone breaks larger than can be handled by the shovels, is done with I-R jack hammers. Two stationary Sullivan air compressors moved to the work from Muscle Shoals furnish the air for the drilling. They are cross-compound units of 2,300 cubic feet per minute capacity each. In addition there is one 1,000-cubic foot Bury duplex-tandem compressor also delivering air at 100 pounds pressure.

The quarry is located about 1,000 feet from the compressor plant and air is delivered to the drilling by a 6-inch line with about 500 feet of 12-inch spiral welded pipe at the quarry end for receiver effect. This 12-inch pipe was used originally for the hydraulic operations.

The blasting is done as soon as a section is ready and on no special schedule. The quarry is cleared for a considerable area even outside the immediate vicinity and the blast shot direct from the power line. Several standard brands of 40 per cent gelatin dynamite are used.

The broken material is loaded with two 3-yard electric shovels, a Bucyrus-Erie 75B and a Marion 4101. The quarry floor is immediately cleaned up after every blast by a Caterpillar Thirty with a LaPlant-Choate bulldozer. This unit also keeps the pit in order close by the shovels during their work of handling much larger material than would be possible with even several pit men.

Another tractor unit that is proving its value is an Allis-Chalmers Model L tractor with a Euclid bulldozer and in the back an Isaacson 2-drum hoist. This machine is used all over the work wherever hoisting power is needed as, with the cableways on the dam, there is not the usual array of derricks for handling and lifting of minor parts or equipment.

Two Hug trucks and four White trucks with 12-yard Hoover Dam type rear-dump bodies haul the rock from the shovels to the crusher. Four of these trucks are in regular service. Their large bodies serve as excellent shelters for drivers and quarry workers whenever a blast is shot in the quarry.

The Crushing and Screening Plant

The normal capacity of the crushing and screening plant is 300 tons an hour, with a maximum capacity of 25 per cent in excess of that figure. The trucks dump directly into the Allis-Chalmers 42-inch gyratory crusher driven by a 250-hp General Electric motor. This unit will produce rock much in excess of the plant capacity. It delivers to a surge bin and thence through a Jeffrey-Traylor vibrating feeder to a 300-ton per hour 334-foot Robins conveyor driven by a 60-hp Westinghouse gear motor and carrying a 36-inch Manhattan 8-ply rubber belt, the entire unit being covered with a corrugated iron roof to protect it from scattered shots from the quarry.

This belt delivers to a Robins 2-deck screen which carries all material over 6-inch to the secondary crusher. Sizes passing the 6-inch screen and retained on the 3-inch lower screen may be delivered to the secondary crusher if more fine material is needed or through a by-pass, with the minus 3-inch material, to the outhaul belt to the screens. In this manner it is easily possible to maintain a proper proportion of the various sizes of stone in the different bins.

The secondary crusher is a Symons-Nordberg 5½-foot standard cone crusher driven by a General Electric 200-

hp motor through a flexible coupling. This crusher also delivers to the same outhaul belt, which is a 369-foot Robins conveyor with a 30-inch Manhattan 8-ply belt delivering to a shorter Robins conveyor with a 30-inch Hewitt 5-ply belt driven by a Century 10-hp motor. This short belt is set at an angle with the longer outhaul belt and saved placing the end of the longer belt at the mid-point of a truss.

There are four screens with transfer belts for carrying the undersize to the next screen. These screens are placed at the mid-points of the 80-foot truss spans. The end structures supporting the trusses are towers and the three inside supports are bents. The screen sizes are 3-inch, 1½-inch, ¾-inch and ⅜-inch. The 3-inch screen is a Niagara one-deck screen vibrated by a Century 5-hp motor, the 1½-inch screen is a Stephens-Adamson one-deck screen vibrated by a Century 5-hp motor, the ¾-inch screen is also a Stephens-Adamson unit vibrated by a 3-hp Century motor, and the two ⅜-inch screens are of the same make and type. The transfer conveyors are all Robins units driven by Century motors and with 30, 24, and 20-inch Acme 4-ply belts respectively. The Century motors driving the conveyors are direct-connected through Falk reducers. Falk flexible couplings transmit the power to the head pulleys.

Aggregate Storage

The aggregate is stored over a concrete tunnel 6 feet 6 inches high, 6 feet wide and 646 feet long through which runs a Robins conveyor with a Hewitt 30-inch, 5-ply belt driven by a Westinghouse gear motor for carrying out the selected aggregates to the batching plant. If there is an excess in the production of any size of stone it can be diverted, before it is piled on the belt in the tunnel, to a 220-foot Robins conveyor with an 18-inch Acme 4-ply belt driven by a Century 5-hp

PROCESSING THE AGGREGATE FOR THE CONCRETE

1. ***The 42-inch gyratory crusher, with the quarry in the background.*** *2. One of the long conveyors carrying large stone to the central mixing plant. 3. The hammermill installation which produces cubical sand grains from the tough dolomite rock. 4. The 6,000-barrel steel cement silo at the dam site, and one of the 65-barrel semi-trailer cement tanks.*

motor which carries the excess to the sand plant.

An interesting and economical feature of the supporting of all the conveyors is that the supports are all of steel while the frames for the conveyors are wood carried on the steel supports to avoid excessive steel detailing and to make adjustments in the setting of the structure very easy, for a bolt can be put through a wood frame at any point with no trouble while the whole would have had to be set up to the limit of accuracy if shop holes had been required to match in the field.

THE SAND PLANT

The excess aggregate outhaul belt delivers to a 100-foot Robins conveyor with an 18-inch Thermoid 4-ply belt at right angles to it. This conveyor handles all material for the sand plant to a surge bin which has one hour's storage capacity.

The engineers had anticipated some trouble in producing sand from this aggregate and so experimented with all types of machines for pulverizing the stone. By the hammermill method, which was chosen, the sand produced gives the same plasticity with 5 per cent less cement than the sand produced by rolls or pressure crushers.

The aggregate to be reduced to sand is delivered from the surge bin to the two Allis-Chalmers hammermills

THE PRODUCTION AND PLACING OF CONCRETE

1. The lower section of the central mixing plant, showing the turntable with the delivery spouts for aggregate at the top, the three tilting mixers and one of the special industrial railway transfer cars and locomotive. 2. Three of the five dial scales for one of the two batteries of weighing batchers, showing also the pneumatic control table and the dispatcher's office. 3. A close-up of the three 3-yard tilting mixers which deliver to a common hopper. 4. One of the concrete transfer cars in position to deliver concrete to the cableway bucket. The background gives an excellent idea of the character of the dam site. 5. One of the head towers of the two cableways showing the bulk cement silo in the background at the left, and the central mixing plant below and to the right. 6. The character of the rock formation and typical form work.

by two Jeffrey-Traylor 48 x 60-inch heavy-duty feeders set on a slight slope and vibrated to give continuous feed. From the hammermills a 200-foot Robins conveyor with a 20-inch 5-ply Thermoid belt driven by a Century 15-hp motor carries the sand to four Allis-Chalmers double-deck vibrated screens fitted with ⅜-inch and No. 8 screens. Oversize sand is recirculated to the hammermills by a 200-foot Robins conveyor with a 16-inch Thermoid 3-ply belt driven by a 5-hp Century motor. Inasmuch as the tendency is to make too much of the coarse sand, a considerable portion has to be recirculated to keep the two sizes of sand in proper balance. The plant must produce about 60 tons per hour of fine sand and 20 tons per hour of coarse sand to maintain the needed ratio.

Coarse sand is outhauled on a 157-foot Robins conveyor with a 16-inch 3-ply Thermoid belt driven by a 3-hp Century motor. This belt feeds the fixed stacker, a 98-foot Barber-Greene conveyor with a 16-inch 3-ply Diamond belt, driven by a 3-hp General Electric gear motor. The fixed stacker delivers the coarse sand to storage over the tunnel, while an 85-foot Barber-Greene radial boom stacker with light conveying equipment piles the fine sand. Before being stacked the fine sand is cleaned in a 12-foot Dorr or 15-foot Link-Belt Rotoscoop washer to remove dust which is wasted with the water.

From the tunnel belt there is a tap-off with overhead loading for trucks so that stone may be taken to other points than to the bins at the mixing plant. The delivery conveyor to the bins is a 228-foot Link-Belt conveyor with a 30-inch 8-ply Manhattan belt.

Handling Bulk Cement

Several brands of moderate heat cement are used for the concrete at Norris Dam. All cement used is delivered in bulk in box cars at Coal Creek, 4½ miles from the dam site and hauled by truck up the maximum 8 per cent grade of the construction road to the dam. The cement is unloaded by a Fuller-Kinyon portable pump delivering either to the 6,000-barrel steel silo at Coal Creek or to one of the 65-barrel cement hauling units. There are three cement trucks composed of International chassis with aluminum 65-barrel tanks on Fruehauf semi-trailers. Compressed air for operating the cement pump is furnished at Coal Creek by a Gardner-Denver 600-cubic foot stationary compressor.

At Norris Dam trucks are dumped by lifting the tank body at the front end with an overhead electric hoist and delivering the cement into a receiving hopper from which it is raised to the duplicate 6,000-barrel steel silo on the hill above the mixing plant, or to the mixer direct by a stationary Fuller-Kinyon cement pump. The pump can also deliver from the silo to the mixer.

The Mixing Plant

The central mixing plant is a novel structure housing eight bins, eight batchers and three mixers. There are two cement bins of 166 cubic yards capacity each, one bin of 208 yards for No. 8 or fine sand, one of 208 yards for the ⅜-inch or coarse sand, one of 124 yards for the ¾-inch or fine stone, one of 128 yards for the 1½-inch or medium stone, one of 175 yards for the 3-inch or coarse stone, and one of 250 yards for the 6-inch or cobble stone. Each of these bins has beneath it a

Spotting One of the 6-Yard Bottom-Dump Concrete Buckets

Johnson weighing hopper batcher with Kron scales. The weights of an average batch as originally planned have been changed by reducing the cement.

Cement	1,241 pounds
Fine sand	2,976 pounds
Coarse sand	860 pounds
Fine stone	1,398 pounds
Medium stone	1,398 pounds
Coarse stone	1,505 pounds
Cobble	2,796 pounds
Water	807 pounds
Cement water ratio	0.65

The batch weight is 12,801 pounds producing a 3-yard mix.

The gates for filling the batchers from the bins are air-operated through two lever banks, one on either side of the upper platform, with one man for each. Thus all batching is done by only two men on a shift. A Worthington portable air compressor is set up beneath the mixing plant to furnish air for the cement pump and for the air control of the gates in the weighing batch hoppers. There are five illuminated arrows on each dial, the one lighted indicating the amount of that particular material that is to be put into the next batch. These lights are controlled from the dispatcher's office at one corner of the platform. When he receives word from the inspector out on the job that a certain kind of concrete is wanted, he plugs in the correct combination on his board and the predetermined combination of lights shows up on the Kron scale dials. This eliminates any possible error in the make-up of a batch. There are five different types of mix used:

1. Mass concrete
2. Exposed face concrete, slightly richer
3. A grout for starting a pour
4. Reinforced concrete, without cobbles
5. Reinforced concrete, without coarse stone, for thin sections.

The Device for Stripping the Forms

When the signal is given, the two batch men dump their batchers simultaneously to a single collecting hopper which is on a turntable so that it is directed to the next one of the three Smith 3-yard tilting mixers to be charged. These mixers are set at 120 degrees to each other and discharge into the same hole to a transfer car on the track below. As a precaution against any mixer being charged through error at the time it is discharging a batch, which is mixed a full 3 minutes, there is a small chute on the turntable that is raised when the mixer tilts and will divert any such material over the side of the platform. The chute for the water is on the same turntable just under the chute for the dry materials. The Smith 84-S tilting mixers are operated by 40-hp Louis-Allis 1,200-rpm splash-proof motors through multiple V-belt drive.

The transfer cars were manufactured by Insley to TVA design and carry two 4-yard tilting skips, in each of which only 3 yards of concrete are carried to prevent spilling. The two skips dump to the center of the car through a hoisting mechanism for each skip controlled from the hauling locomotives and with the power supplied by the locomotive generator. Electric limiting switches on the hoisting mechanism prevent over-hoisting of the skips and also stop the skip motors when the skips have reached the lowered position.

The three cars are each hauled by 8-ton Plymouth locomotives on a trestle at the elevation of the crest of the dam from the mixing plant to the cableway buckets. The concrete is discharged into a hopper at the center of the car which acts as a side-discharge funnel to charge the cableway buckets for the final placing of the concrete.

The Cableways

There are two cableways of 1,925 feet 6 inches span which handle loads up to 18 tons each over the entire area of the dam. The tracks are 450 feet long and as both the head and tail towers move back and forth along the rails they are necessarily counterbalanced. This is done through large concrete weights carried at the back of the tower platforms. To carry the thrust load, the rails are tied to anchors in rock on the head tower side and to deadmen in earth on the tail tower side. The tail towers are operated by remote control from the operator's cab on the head tower. A set of targets or stations are marked with large numbers on black backgrounds on both sides of the valley so that the tower operators may readily spot the towers in accordance with the instructions of the inspector down in the pit. All directions are given by telephone, the man in the pit having a head set and long cable permitting him to move about readily and the operator having a loud speaker in front of him in the cab. Only an oiler remains in the tail tower.

The steel towers were built by the Virginia Bridge & Iron Co., the head towers being 75 feet high and the tail towers 110 feet. The main track cable is a 3-inch round Locked Coil cable furnished by the American Steel & Wire Co. The conveying ropes are 1-inch plow steel, the hoisting ropes and the dumping ropes plow steel ⅞-inch in diameter. The towers move at 50 feet per minute, the trolley speed is 1,200 feet per minute, the hoisting speed is 300 feet and the lowering speed 405 feet. The 3-drum hoist for the towers was furnished by Lidgerwood and has one drum for hoisting, one for dump and one for the endless cable. There is a 400-hp General Electric hoist motor and a 75-hp tracking motor in each tower.

Rate of Concreting with Towers

The estimated capacity of the concreting plant including the three mixers and the two towers is 3,000 yards per 22-hour day. The plant has reached 1,862 yards, using one cableway for the full time and the other for part time during a daylight shift. The rate of 1,500 yards for a 22-hour day has been exceeded by one tower working alone.

The entire dam site is floodlighted by 1,000-watt lights with reflectors suspended between the cableway towers across the valley.

Forms for Dam Blocks

For ease in designation the entire dam is laid out in blocks 56 feet wide and numbered and lettered according to position. These blocks are the units for concreting and the panel forms are built accordingly. The panels are 20 feet long and 5 feet high with 1⅝-inch lagging, 4 x 6-inch studs and 8 x 8-inch wales. They are handled by Krane Kars, made by the Silent Winch Co., which have a capacity of 5,000 pounds and are spotted on the block by the cableways. One of these cars handles all the forms for a block, stripping and setting a panel in the same operation.

The method of stripping the forms is novel and effective. An eye bolt is run through the top of each wale horizontally, with the eye toward the lagging. This is the place where the stripping device gets its hold on the forms. The stripping device is simply a pair of L-shaped pieces of metal spaced apart with pipe spacers the exact thickness of the eye bolt head. A hole is turned out of the short leg of the device to hold a pin which fits the eye bolt. The stripping device is placed on the form with the pin through the eye bolt and with the heel of the stripper against the lagging of the next form. Then a vertical pull by the Krane Kar slowly but surely and effectively forces the form away from the concrete.

The concrete is placed in the forms by a special 6-yard Insley bottom-dump bucket designed by TVA engineers. The buckets have been equipped for pneumatic dumping by installing pistons in a bottom compartment

which raises the arm that must be lifted to release the bottom gates. This is operated by a small air line with a pet cock and a rubber nipple that fits tightly over the end of the piston nipple and is carried by the bucket man on the block. When the bucket has been spotted by the signal man by telephone, the bucket man slips the air hose over the piston nipple and turns the pet cock. This immediately releases the gates by throwing the lever operating the arm. The man doing this has to get out of the way rather rapidly as the bucket raises about 15 feet in the air as soon as the load is released, due to the spring of the cableway. The mass concrete in the blocks is vibrated by two Jackson electric vibrators as soon as placed by the bucket.

Before a second 5-foot lift is poured in a block, the top is scoured with a stream of water and air under high pressure to remove all loose material and laitance. This is gathered up in wheelbarrows and removed from the block.

Labor Organization and Hours

The work is pushed six days a week on this project with common labor working four 5½-hour shifts and general foremen three 8-hour shifts. Rates of pay run from 45 cents an hour for common labor to $1.00 an hour for skilled labor.

The shifts work as follows: 12 A.M. to 5:30 A. M., then one hour off for breakfast; 6:30 A. M. to 12 noon, then an hour for dinner; 1 P. M. to 6:30 P. M.; and 6:30 P. M. to midnight.

Repair Shops and Service Units

On the east bank of the Clinch River, reached from the west bank where the engineering and administrative offices are located by a heavy temporary bridge, are the blacksmith shop, storage for reinforcing, the welding shop, carpenter and electric shops, the infirmary, and the Chicago Bridge & Iron Works erection yard for the steel penstocks for the power house.

Personnel

Norris Dam, the first major construction job of the program of the Tennessee Valley Authority, is being built by force account from appropriations set apart from PWA funds for this purpose with the following engineering and construction personnel in active charge of the work: Barton M. Jones, Chief Engineer; C. D. Riddle, Assistant Chief Engineer; Ross White, Construction Superintendent; E. M. Whipple, Assistant Superintendent; and F. S. Schlemmer, Assistant Superintendent.

Big Contractor — Big Grading Project— Little Fuss and Fast Work

A. Guthrie & Co. of St. Paul, Minn., Used Heavy Equipment on 15.33-Mile Mississippi Highway Contract

"IT LOOKS like the circus has come to town," remarked one of the natives when the trainload of 45 cars of draglines, crawler wagons and tractors as well as camp equipment belonging to A. Guthrie & Co. for use on its Lumberton- Purvis and Hattiesburg-Brooklyn, Miss., state highway contracts arrived at the siding at Hattiesburg for unloading. And true it was, for the contractor not only had his equipment but the living quarters for his entire outfit packed on those cars.

The Hattiesburg-Brooklyn contract which included grading, drainage and a 10.6-mile tangent provided some interesting methods for discussion. Work was started January 18, 1934, and the burden of the excavation amounting to 400,000 cubic yards was well distributed throughout the job rather than being concentrated in any one or two cuts. The major portion of the excavation was handled by two Austin power-operated elevatting graders with 48-inch belts pulled by Caterpillar Seventy-Five diesel tractors loading to trains of two 7-yard Euclid crawler wagons, drawn by Caterpillar Sixties and other diesel Seventy-Fives.

Where there were heavy mats of roots at the bottom of fills and the ground was at all unstable, the contractor blasted or excavated the mats so that the fill could "hit bottom" at the start. The fill was spread in 12-inch lifts on spongy bottoms by a LaPlant-Choate bulldozer mounted on a Caterpillar Sixty.

The longest cut on the job was only 800 feet long and the hauls were well within 1,000 feet on an average, although the State requires a half-mile free haul. The sequence of operations in making a cut was first to cut the drainage ditches and then take off the excavation in lifts, running the elevating grader back and forth through the cut. The flared sections of the cuts for drainage were made with a Northwest dragline which was also used for shallow borrow where several cuts were widened for the additional material for fills.

There were several sections where pipe clay was found and the contractor excavated to 2 feet below grade and backfilled with selected material. This pipe clay is treacherous material. When first exposed dry it is as hard as rock, when wet it has no stability and in drying has a shrinkage factor of about 50 per cent. When first exposed dry in one perpendicular cut, the pipe clay could not be worked with a dragline as the teeth of the bucket only slid over the surface, literally just scratching it. Because of this characteristic of the pipe clay, at one point it was necessary to blast out about 8,000 yards so that the dragline could handle the material rapidly.

A Caterpillar Sixty tractor with an Ateco scraper with hydraulic control and with a roller attached was used for finish grading and also for some of the shallow cuts and for flaring a few of the cuts.

DRAINAGE

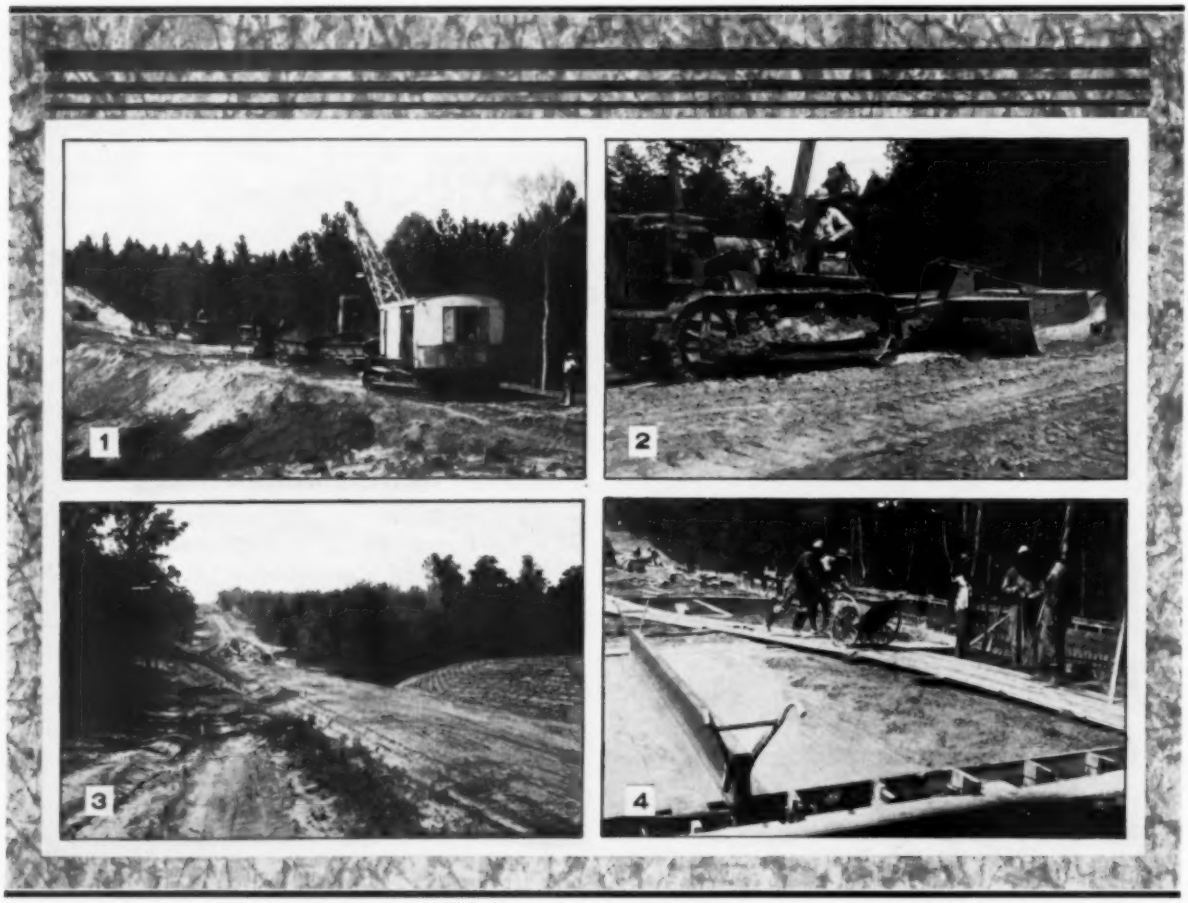
An interesting drainage problem arose during the work where the plans called for three culverts at approximately Stations 602, 603 and 605. This was at the location of a muck hole and, by a little figuring at the site, the plans were changed to put through one culvert, necessitating excavation of a downstream channel through a small hill but eliminating one culvert. The drainage areas they were to have cared for were diverted into the other by ditches and to support the entire fill over this muck hole a false berm was laid down on either side of the 8-foot fill.

There were fifty-eight box culverts on the job, varying in size from 2 x 2 feet to 12 x 5 feet and in length from 36 to 113 feet. There were also eight small bridges. Two one-bag Ransome and one two-bag Jaeger mixers were used for mixing all the concrete for the entire set of culverts and bridges.

LUBRICATION

All greasing of equipment was done at night and the greasing train was as complete as one could ask. It consisted of a 600-gallon fuel oil tank at the head of

(Continued on page 36)



GRADING AND DRAINAGE STRUCTURES ON THE A. GUTHRIE & CO. HATTIESBURG-BROOKLYN, MISS., CONTRACT

1. A dragline loading trains of crawler wagons in finishing slope at the end of a fill. 2. A combined hydraulic scraper and roller finishing grade. 3. A long shot on the tangent; showing the last bridge under construction, a flared cut and sodding. 4. Concrete methods in bridge construction.

The Lubrication *of* Pneumatic Equipment

The Eleventh of a Series of Articles on an Important Phase of the Maintenance of Construction Equipment

THE lubrication of air compressor cylinders has been simplified to a considerable extent, as it is essential to use a fluid lubricant, either oil or liquid grease. The operator's problem is the selection of that lubricant which has the proper physical characteristics to lubricate efficiently the cylinders of his compressor with the minimum carbonization of the lubricant. Carbon formation on the cylinder valves, in the cylinder passages and air lines is most troublesome and frequently very dangerous. Carbon deposits on the air valves necessitate their being cleaned at frequent intervals to prevent their sticking or partial closing. The objections to this carbonization, aside from the sticking of air valves and choking of the air passages, is the menace of fire entailed by carbon deposits. Particles of carbon may be torn loose from them and become glowing from the extreme heat. Should they come in contact with oil vapor given off by the lubricating oil, a conflagration might be started which would be more or less disastrous, in proportion to the volume of carbon which had been permitted to accumulate in the compressor and air lines.

Explosions in compressors or air lines are not at all infrequent and in several instances on record have resulted in heavy property loss as well as loss of life. Carbon deposits, in their early stages, are inclined to be sticky and cling to the walls of the pipe, but through the action of heat passing over them they become hard and flinty. The accumulation is comparatively rapid and eventually the orifice through which the air passes is reduced to such an extent that the pressure is increased beyond the tensile strength of the line and an explosion is sooner or later inevitable. Lines should be inspected at stated intervals and carbon deposits removed or lines replaced. The formation of excessive carbon deposits may be due to the use of too much oil, the use of a steam cylinder oil, which on exposure to the heat of the air cylinder creates a tarry deposit, or the use of oils of too high a viscosity which do not atomize readily.

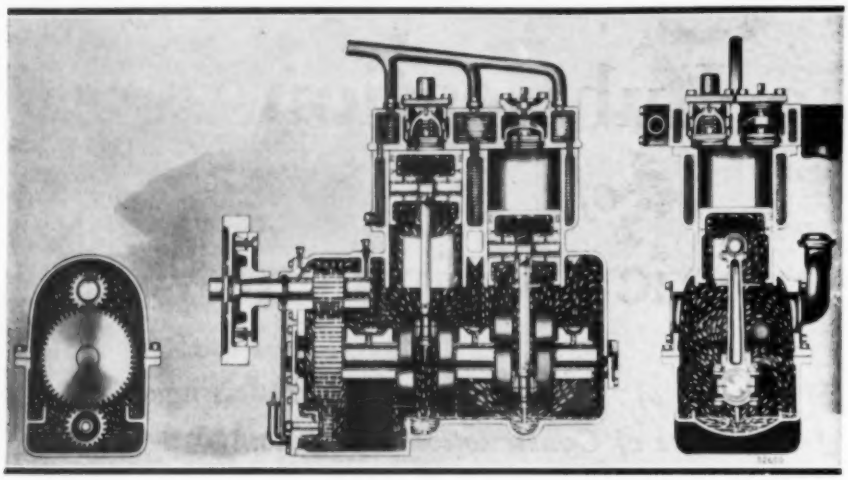
Proper Lubricants for Compressors

The lubricating requirements of air compressor cylinders differ from the lubricating requirements of steam cylinders as there is no moisture present, but there is the intense dry heat of compression to contend with, which has the tendency to reduce the body of the lubricant and cause it to vaporize. There is no set specification for an air cylinder lubricant, as operating conditions and compressor capacities necessarily govern the requirements to a considerable extent. The following table might be considered a very satisfactory guide for compressors operating under normal surroundings:

Lbs. Press. per Sq. in.	Base of Oil	Viscosity at 100° F.	Flash Point (Minimum)
100	Paraffine	250	400 degrees F.
	Asphaltum	320	350 degrees F.
150	Paraffine	300	420 degrees F.
	Asphaltum	430	380 degrees F.
200 (or more)	Paraffine	400	445 degrees F.
	Asphaltum	750	430 degrees F.

It is claimed by some lubricant manufacturers that, strictly from an operating standpoint, there is no distinction between the paraffine base oils and the asphaltic base oils as to their desirability as compressor cylinder oils, provided that both have been properly filtered in the process of manufacture to remove the carbon-forming elements. What carbon might form from the paraffine base oil would be very adhesive and of a hard flinty nature, while that formed from the asphaltic base oil would be of a fluffy nature and easily cleaned out.

There is an erroneous impression prevailing in the minds of many engineers operating compressors that an excessive feed of oil to the air cylinders is essential to efficient performance. If the correct type and viscosity of oil is used, from two to six drops per minute per cylinder is sufficient to lubricate cylinders up to 24 x 24-inch dimensions. Larger cylinders would require more in proportion to their size. Fluid grease lubricants of good quality have been found to be very satisfactory as air cylinder lubricants, because a well-made lubricant of this character is inclined to be more adhesive than straight mineral oils and forms a more tenacious film on the walls of the cylinder. When a fluid grease lubricant is used it should be of the lightest consistency and a lesser amount should be fed to the cylinder than when oil is used. When the air com-



A Sectional View of an Ingersoll-Rand Portable Compressor Showing the Splash System of Lubrication

pressor is lubricated by a splash system of lubrication, the oil level should be maintained as near as possible at all times and the oil changed at least once a month of running time. For winter use at temperatures of 32 degrees F. and below, the lubricant should have a cold test of 15 degrees F. or below, when the machines are exposed to outside elements.

Never use kerosene or gasoline to clean out air cylinders, crankcase or pipe lines. This is dangerous and should be prohibited as it will cause an explosion.

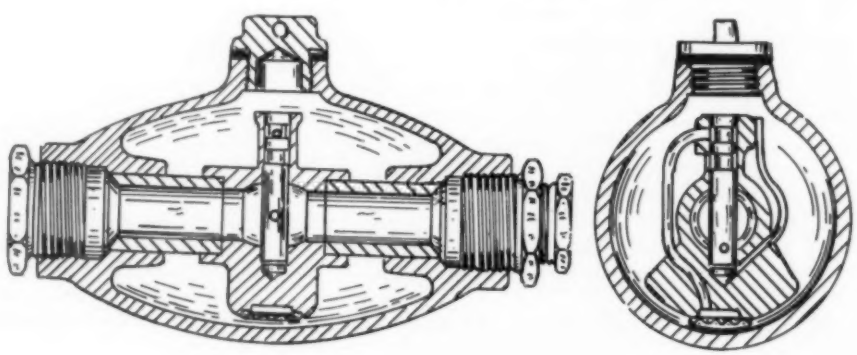
Pneumatic Tools

The lubrication of pneumatic tools does not present as complicated a subject as the lubrication of many other units of contractors' equipment. The dominating factors are cleanliness and the selection of the proper lubricant. Special attention should be given to the air used, and wherever possible it should be drawn from the outside and, as a precautionary measure, should be passed through an air filter placed over the inlet. Fine dust and other foreign matter which is carried through the lines to various mechanical parts by the air is invariably absorbed by the lubricant and is immediately carried to all working parts of the machine, where it acts as an abrasive and causes rapid deterioration of the bearings.

The gears and crankcases of rotary air drills operate with greater efficiency when a semi-fluid lubricant is used. It should be comparable with a standard density of grease of about a No. 1 consistency. The compressed air does not come in contact with these parts. The grease lubricant may be applied or forced into the crankcases through the medium of a pressure gun. A good lubricant of this character should not require replenishing more frequently than once every eight or ten hours of operation. The lubricant used should show no tendency towards foaming as this is detrimental to its proper functioning. When the machine is in use, the rapid rotation of the crank carries or throws a sufficient amount of the lubricant into the cylinders to lubricate them properly, and a small quantity also works around the drill spindle.

Quality of Oil Most Important

Several desirable qualities are essential for rock drill oils if lubricating troubles are to be maintained at a minimum. The oil should form a good emulsion with air and water so it will not be readily washed off the drill parts, especially with wet drills. There should be no inclination to gum or leave a sticky deposit on any operating part, as it would retard the valve action and prevent the proper starting and running of the machine. It should not leave a carbon deposit when exposed to high temperatures as are frequently experienced in paving breakers, where the air coming from the compressor through short air lines and small receivers does not have time to cool. High pressures are sometimes built up in some parts of the drills and frequently reach as much as 1,000 pounds per square inch. The oil should be of a quality and sufficiently viscous as



Longitudinal and Transverse Sections of a Gardner-Denver Automatic Air Line Oiler

not to break down and lose its adhesive properties under pressure and high speeds. Piston speeds of steel upon steel reach 2,000 feet per minute. There should be no tendency of the oil to smoke or fog, contaminating atmosphere and making it undesirable to breathe especially in close quarters. The expansion of the air frequently causes the temperature to fall below freezing, and very often drills are operated under much lower temperature conditions. Therefore, it is essential that the lubricant possess a low pour test.

Practically all pneumatic tool manufacturers stress the importance of using the best grades of oil obtainable in their machines, as they realize the reputation of the machine is dependent to a greater or lesser degree on the drilling speed attained, and poor grades of oil tend to retard rapid operation. Drills are subjected to hard usage and under the most favorable conditions excessive repair bills are incurred, which may be materially reduced by the selection of proper oils for their lubrication. When the oil is fed direct to the machine the supply should not be permitted to run low as that detracts from the machine's efficiency.

Automatic Air Line Lubrication

Line oilers are now commonly used and, generally speaking, they have been found to be most satisfactory as they operate automatically and a sufficient volume of lubricant is carried to the working parts with the air to keep those parts lubricated constantly while in operation. Care should be taken to prevent the supply in the oiler from becoming exhausted and inspections should be made once or twice each shift so that the oil supply may be replenished when necessary.

Specifications

A good oil to use on pneumatic drills, hammers, etc., should have the following general specifications:

LIGHT DRILLS

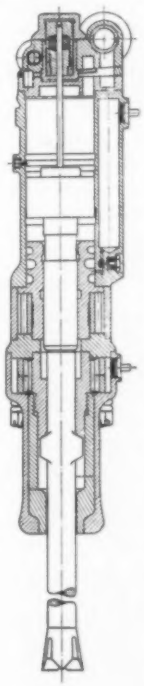
Flash Point.....357 degrees F. Minimum.
Viscosity.....300 to 500 Sec. at 100 degrees F.
Pour Test.....10 degrees F. Maximum.

HEAVY DRILLS

Flash Point.....375 degrees F. Minimum.
Viscosity.....500 to 700 Sec. at 100 degrees F.
Pour Test.....10 degrees F. Maximum.

A light consistency of liquid grease may be used with very satisfactory results in the larger drills, providing the oil with which it is made is of a good quality with a viscosity of at least 300 seconds at 100 degrees F. This type of lubricant, if well made, is adhesive and has good lubricating properties. The pour test of such a lubricant should not be higher than 10 degrees F.

Under no circumstances should castor oil or castor machine oil be used for drill lubrication.



A Longitudinal Section of a Worthington Rock Hammer, Showing the Moving Parts Where Lubrication Is Essential

Properties of Concrete Studied in Test Section

AN abstract of a report on laboratory and field tests of the Bayshore Highway cooperative investigation has recently been issued by the Highway Research Board of the National Research Council. The report gives the results obtained during 1933 of a series of investigations into the properties of concrete used in the construction of a test section of the Bayshore Highway near San Francisco, Calif. The primary purpose was to compare the effects of various cements upon the qualities of concrete pavements. Both laboratory and field tests indicate no marked differences in strength, durability or volume changes among the twelve different cements tested; but there was a very pronounced curling action of all slabs due to drying of the top while the bottom remained moist. This curling action is shown to be more important than the volume changes of the slab as a whole. The results indicate that factors other than the cements may be varied to control the curling and volume changes.

A number of facts interesting to both engineers of design and to contractors were observed particularly in the field tests. The maximum temperature of concrete after casting was influenced to a large extent by the temperature conditions during and soon after casting; the greatest maximum temperature developing in concrete cast near noon. The temperature rise, due to the heat of hydration, for high-early-strength cements was approximately 6 degrees F. greater than for other cements.

The maximum contraction of the slab as a whole, due to temperature changes, including the drop from the hardening temperature to normal and including the daily and seasonal variations, for the average of all cements was approximately 5/16-inch per 100 feet of length. For high-early-strength cements, the contraction was greater than for standard cements, due to their higher temperatures of setting. The contraction of the slab as a whole due to causes other than temperature change, chiefly drying, was, up to the age of one year, somewhat greater than ⅜-inch per 100 feet of length. The indications are that the contraction at the end of the present dry season will not greatly exceed ⅛-inch per 100 feet or approximately one-tenth of that which would occur in a slab subject to drying throughout. The contraction was not greatly different for the individual cements, and the high-early-strength type showed no greater contraction than standard cements.

The daily curling of slabs due to temperature change was sufficient to produce an alternate rise and fall of the ends of an unrestrained 20-foot slab of 1/16-inch downward during the day and 1/16-inch upward during the night, or a total range of ⅛-inch. The curling of slabs due to drying, up to the age of one year, was sufficient to cause the ends of an unrestrained 20-foot slab to rise 5/16-inch. The indications are that the curling occurring during each dry season is only partly compensated by the curling in the opposite direction during the subsequent wet season.

Within the first year, the contraction of the slab as a whole, due to moisture change, was only 50 per cent of that due to temperature change; while the curling of the slab due to moisture change was five times that due to temperature change.

Surface cracks of varying width up to about 0.002-inch developed in all field test slabs, due to non-linear variation of temperature and of the moisture content from the top to the bottom. The surface cracks were largest and most numerous in the field test slabs for the cement which exhibited greatest contraction under the extreme drying conditions of the laboratory tests. Likewise, the surface cracks were smallest and least numerous for the cement which exhibited least contraction in the laboratory tests.

Daily variations in the temperature of the field test slabs were greater for cements of darker color, as would be expected. Slabs differing only in natural color differed by as much as 8 degrees F in surface temperature when the sun was shining.

Are You Losing Profits

through

Lost Time?

Part II

Reported by
C. F. Rogers

Assistant Highway Engineer
U. S. Bureau of Public Roads

TIME is money, as contractors have often learned to their sorrow, when it was too late to do anything about recovering the lost profits. This article, based on studies of 23 bituminous road projects made by the Division of Management, U. S. Bureau of Public Roads, and continued from the October issue, offers practical suggestions for plant and job management which will greatly decrease or even eliminate lost time through inefficiency or carelessness.

Projects Rated According to Efficiency of Production

Efficiency of production during utilized time involves the inherent rates of production of the units making up the plant, practices in operating the plant and specification requirements. Table 2 shows details concerning the mixing cycles on each of the twenty-three jobs, the output of the plants and their over-all efficiency. The mixing cycles shown represent the actual average performance during utilized time.

Mixing cycles range from 46.8 seconds to 87.4 seconds with the corresponding batches per hour ranging from 76.9 to 41.2. The plant with the smallest batch (0.309 ton) had a mixing cycle of 58.6 seconds with a resulting possible output of 19 tons per hour. A plant producing batches in excess of 2 tons in a cycle of 49.2 seconds, had a possible output of 150 tons per hour or 8 times the amount of the smaller plant.

In Table 3 the total job tonnage and the utilized time are used to determine the rate of production per utilized hour. Since utilized time represents operation at maximum efficiency, this figure also represents maximum possible production or plant capacity. Working hours and total tons produced are used to determine the production per working hour. The percentage of plant capacity attained is the same as the percentage of working time utilized. Production per available hour is also shown.

The production of a plant depends on both the inherent limitations of the plant equipment and on the efficiency with which it is operated. An index of production may be obtained by multiplying the plant capacity in tons per hour by the over-all efficiency. Such an index for each plant is shown in Table 3, which is arranged in descending order of indices. If the job with the highest index of production, No. 23, be accepted as having maximum production, or 100 per cent, we can then compute the percentage of maximum attained on the other projects as shown in the table.

TABLE 2.—OPERATING CHARACTERISTICS AND EFFICIENCY OF PLANTS STUDIED

Job No.	Operating Characteristics of Mixer				Possible Batches Per Hour	Average Batch	Possible Production Per Hour	Production During Study	Attained Production Per Working Hour	Ratio of Attained Production to Plant Capacity	Production Per Available Hour	Over-all Efficiency
	Charge	Mix	Discharge	Cycle								
	Seconds	*Seconds*	*Seconds*	*Seconds*		*Tons*	*Tons*	*Tons*	*Tons*	*Percent*	*Tons*	*Percent*
1	9.2	43.3	10.5	63.0	57.1	1.174	67.1	25,752	49.8	74.3	42.8	74.6
2	11.1	45.4	12.8	69.3	51.9	1.333	69.2	28,831	48.1	69.5	39.6	69.3
3	10.7	59.0	14.6	84.3	42.7	.599	25.6	5,599	21.6	84.4	12.8	86.3
4	8.1	51.6	3.4	63.1	57.1	.987	56.3	10,705	44.2	78.5	21.3	75.7
5	8.4	39.8	9.8	58.0	62.1	1.566	97.3	38,526	80.9	83.1	66.0	84.2
6	18.6	35.6	5.0	59.2	60.8	.487	29.6	8,807	22.3	75.4	10.8	64.5
7	7.3	38.5	4.0	49.8	72.3	.923	66.8	12,918	38.7	57.9	24.6	51.6
8	8.2	34.8	3.8	46.8	76.9	.523	40.2	4,460	22.0	54.8	16.1	45.7
9	14.0	40.0	8.0	62.0	58.1	1.819	105.7	23,086	75.9	71.9	71.9	70.9
10	12.5	34.3	11.8	58.6	61.4	.309	19.0	6,144	15.5	81.5	6.4	65.1
11	8.1	38.9	4.2	51.2	70.3	.495	34.8	18,658	28.6	82.2	23.8	80.7
12	10.4	41.5	11.4	63.3	56.9	1.188	67.6	18,840	52.2	77.3	41.0	70.8
13	10.8	61.0	9.2	81.0	44.4	.690	30.7	2,393	23.5	76.5	8.3	75.8
14	5.4	72.1	9.9	87.4	41.2	.659	27.1	1,638	22.5	82.9	4.9	80.6
15	10.6	56.6	5.6	72.8	49.5	1.124	55.6	6,198	34.0	61.2	18.5	55.9
16	7.0	41.3	10.0	58.3	61.7	1.523	94.1	25,496	68.0	72.3	28.2	65.5
17	10.0	42.7	8.0	60.7	59.3	.552	32.8	8,148	23.9	79.0	24.7	79.5
18	12.1	33.0	13.7	58.8	61.2	2.035	124.6	40,103	104.5	83.9	101.0	84.5
19	10.0	40.3	13.2	63.5	56.7	1.956	110.9	48,950	95.5	86.1	53.7	77.7
20	8.2	43.4	13.8	65.4	55.0	1.262	69.4	17,554	59.1	85.2	25.5	88.9
21	6.0	40.0	12.2	58.2	61.8	1.563	96.6	39,685	74.8	77.5	48.6	72.6
22	10.8	24.2	14.2	49.2	73.2	2.055	150.4	33,756	126.2	83.9	108.2	82.2
23	9.8	31.3	14.5	55.6	64.8	2.186	141.7	43,556	137.4	97.0	127.9	96.2
Average or total	9.9	43.0	9.7	62.6	57.5	1.290	74.7	460,803	58.4	78.2	37.1	73.9

A Study of the Factors Resulting in Time Losses in the Construction of Mixed Bituminous Pavements Made by the Division of Management, U. S. Bureau of Public Roads

The production of job No. 23, as controlled by the combined plant and management characteristics, was 2½ times that of the average and 11 times that of job No. 10. A later section of the report will show that the unit costs for labor and equipment on each project are in substantially the same order as the indices of production. Job No. 23 was a large project and used a large plant, and it should not be assumed that every project should use such a plant or should attain 100 per cent on the basis used in Table 3.

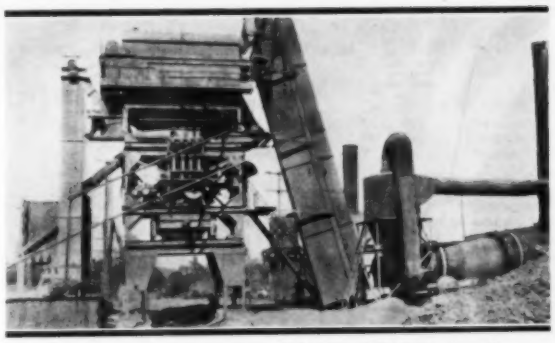
The data of Table 2 are shown graphically in Figure 3 in which the jobs are arranged in numerical order. The upper diagram shows the time of charge, mixing, and discharge for each plant. The middle diagram is a comparison of batch size with a superimposed comparison of the possible batches per hour at each plant—the two factors which determine the possible output. The lower diagram shows the rates in tons per utilized hour, per working hour, and per available hour. These rates are also referred to as plant capacity, attained production, and gross production. These rates cover production on whole road projects and therefore represent average characteristics.

Rates of Production on Three Projects Compared

In a study of production with a view to increasing efficiency we must go beyond average characteristics and examine the fluctuations in output from day to day. Good management will be reflected by a consistent high daily production while inefficient management which permits delays to creep in will show fluctuations.

Figure 4 shows the cumulative rates of production during working time expressed as a percentage of the maximum possible rate on each day of operation on three typical projects. The figures for any day represent the average for all days up to and including that day. There is a marked difference in the general average rates attained at the three plants, which are affected by the size of the plant, specification requirements as to the mixing cycle, and the efficiency of management. The projects were selected particularly to show variations in the effect of fortuitous conditions.

Table 4 shows for each of these three jobs the factors controlling production as actually recorded during working hours and as specified or interpreted in practice. On some of the jobs studied the specifications required a standard mixing time and also limited the number of



A General View of a Modern Well-Designed Plant Set-Up

TABLE 3.—INDICES OF PRODUCTION AND COMPARISON OF PRODUCTION BASED ON ASSUMPTION THAT MAXIMUM PRODUCTION WAS ATTAINED ON JOB NO. 23

Job	Index of production	Percent of maximum	Job	Index of production	Percent of maximum
23	136.2	100.0	4	42.7	31.3
22	123.8	90.0	7	34.5	25.3
18	105.2	77.3	15	31.1	22.8
19	86.1	63.2	11	28.1	20.6
5	81.9	60.1	17	26.1	19.2
9	75.0	55.1	13	23.3	17.1
21	70.2	51.5	3	22.1	16.2
20	61.7	45.3	14	21.9	16.1
16	61.6	45.2	6	19.1	14.0
1	50.1	36.8	8	18.4	13.5
2	47.9	35.2	10	12.4	9.1
12	47.8	35.1			

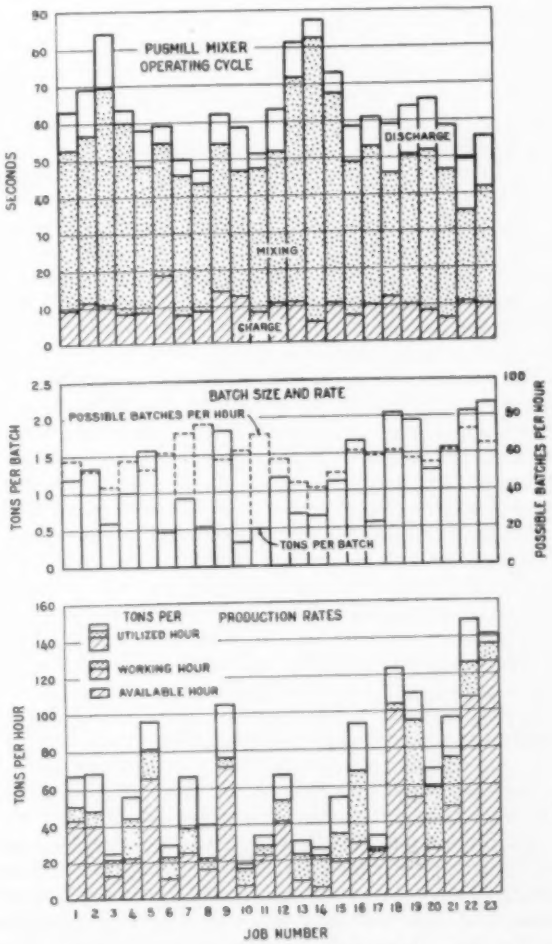


Figure 3. The Effect of the Operating Cycle and Batch Size on Production Rate

TABLE 4.—FACTORS CONTROLLING PRODUCTION AT THREE PLANTS WHOSE PRODUCTION RATES ARE SHOWN IN FIGURE 4

	Actual Limitations			Specified or Plant Limitations		
	Base	Surfacing	Total or Average	Base	Surfacing	Total or Average
Project No. 4						
Charge, seconds	7.2	8.6	8.1	7.2	8.6	7.9
Mix, seconds	33.5	60.7	51.6	30.0	60.0	44.6
Discharge, seconds	4.0	3.0	3.4	4.0	3.0	3.5
Cycle, seconds	44.7	72.3	63.1	41.2	71.6	56.0
Batches per working hour	63.2	30.1	44.8	87.4	50.3	64.3
Tons per batch	.944	.889	.987	1.0	1.0	1.0
Tons per working hour	59.6	34.7	44.2	87.4	50.3	64.3
Working hours	92.2	150.0	242.2	62.9	103.5	166.4
Total tons	5,497	5,208	10,705	5,497	5,208	10,705
Project No. 18						
Charge, seconds	9.9	14.3	12.1	9.9	9.9	9.9
Mix, seconds	44.6	46.4	44.4	32.2	31.4	31.8
Discharge, seconds	13.3	14.1	13.7	13.3	14.1	13.7
Cycle, seconds	67.8	74.8	70.2	55.4	55.4	55.4
Batches per working hour	53.1	48.1	51.3	65	65	65
Tons per batch	2.048	2.009	2.035	2.0	2.0	2.0
Tons per working hour	108.8	96.8	104.5	130	130	130
Working hours	246.0	137.6	383.6	205.9	102.5	308.4
Total tons	26,776	13,327	40,103	26,776	13,327	40,103
Project No. 22						
Charge, seconds	8.6	14.7	10.8	8.6	8.6	8.6
Mix, seconds	33.6	33.9	33.7	29.0	36.5	31.8
Discharge, seconds	13.8	14.9	14.2	13.8	14.9	14.2
Cycle, seconds	56.0	63.5	58.7	51.4	60.0	54.6
Batches per working hour	64.3	56.7	61.3	70.0	60.0	66.0
Tons per batch	2.056	2.053	2.055	2.1	2.1	2.1
Tons per working hour	132.2	116.5	126.2	147.0	126.0	138.6
Working hours	163.1	104.3	267.4	146.9	96.5	243.4
Total tons	21,593	12,163	33,756	21,593	12,163	33,756

batches per working hour at a rate not in harmony with the mixing time—a double standard frequently encountered in this class of work. On the projects studied the limitation on batches per hour was the one usually enforced. Lack of adequate devices for timing the mixing period and the consequent lack of control is the probable cause of the limitation of batches per hour. On recent projects, satisfactory timing devices have been in use and there appears no need for additional limitation.

On job No. 4 different mixing times were specified for base and surface course. With the necessary charge and discharge time the average cycle (specified) was 56 seconds, which permitted 64.3 batches per hour. The mixer was designed for a 1-ton batch, which limited production to 64.3 tons per hour.

On job No. 18 the specification, as interpreted, permitted a mixing time plus one half the discharge time of 45 seconds or alternately a maximum rate of 65 batches per hour. The latter requirement governed. Using a 2-ton batch for which the mixer was designed gave a maximum permissible rate of 130 tons per hour.

On project No. 22 the specification as interpreted required 45 seconds mixing time or alternately permitted 70 batches per hour on base and 60 on surface course. With a 2.1-ton batch the maximum permissible rate (average for two courses) was 138.6 tons per hour. There is a great difference in the efficiency with which these plants were operated. On project No. 22 the cumulative rate of production rose to 90 per cent of the maximum within 7 days after beginning work, and the job was completed in 39 days with an average rate of 91 per cent. On project No. 18 the average rate for the job was slightly more than 80 per cent.

On project No. 4 work was greatly hampered by bad weather and the cumulative rate of production did not reach 70 per cent until the twenty-ninth day and remained at approximately this figure for the remainder of the job. The plant on project No. 18 could have completed this project in 10 days.

A combination of time losses, slow operation, and small plant reduced the output at one plant to 4.9 tons per available hour even though operating at 80.6 per cent efficiency, while another plant reached five times that production while operating at 51.6 per cent efficiency. Still another project produced 108.2 tons per available hour with an efficiency of 82.2 per cent.

The low rates of production attained at some plants indicate that not only should more attention be given to the elimination of avoidable time losses but that consideration should be given to the use of plants of larger capacity. Time losses due to weather cannot be controlled, but when such losses are followed by production which cannot exceed a fixed low rate the unit costs are certain to be high. The desirable size of plant will be affected by fixed daily cost of the outfit, relative plant costs, size of project, and other matters. Equipment and practice are not yet sufficiently standardized to attempt to lay down rules for size of plant but it is quite evident that many jobs justify greater plant capacity with a consequent greater daily production during available time.

(To Be Continued in December)

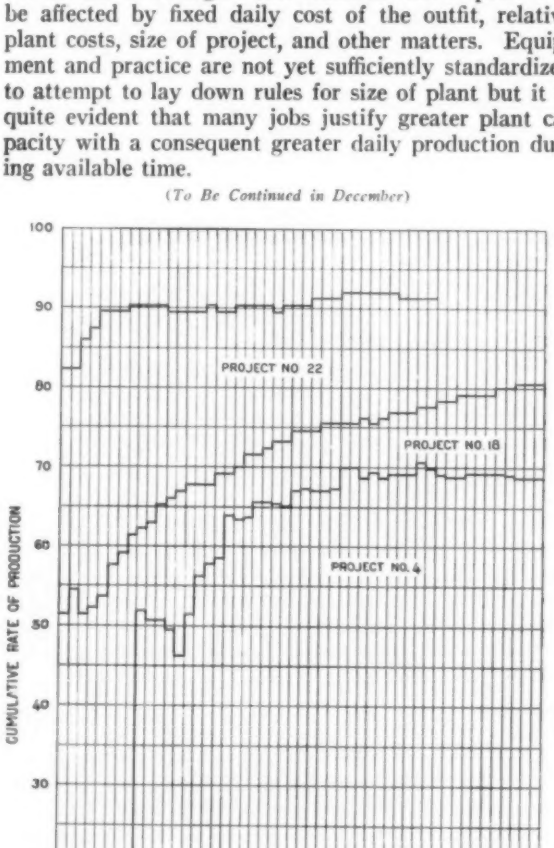


Figure 4. Cumulative Rates of Production at Three Plants During Working Time, Expressed as Percentage of the Maximum Possible Rate. The Plant on Project No. 4 Was Small, Poorly-Managed, and Weather Conditions Were Bad. On Project 18, the Plant Was Large, Well-Managed, and Weather Conditions Were Good. On Project 22, the Plant Was Large and Well-Managed but Weather Conditions Were Only Fair.

1934 Bay State Project

Along Paul Revere's Route

Five Sections of Paving Totalling 15.2 Miles to Improve Historic Highway

EVERY age brings its own particular problems. When Paul Revere made his historic midnight ride from Boston to Concord, his route through the Massachusetts countryside may have been little more than a bridle path, but he was spared the traffic problem. Today traffic over that now famous route is so congested that the most important highway project in Massachusetts in 1934 was the construction of a new road, cutting cleanly between the two existing thoroughfares, Concord and Massachusetts Avenues. The Cambridge-Concord highway, built mostly during 1934, will provide a 40-foot through way and relieve existing arteries already overburdened with heavy traffic. It eliminates the traffic tangles of city streets and does away with railroad and other grade crossings with a series of bridges and underpasses. The right-of-way taken for most of the 15.2 miles of the project is 100 feet wide. The project, financed by PWA highway funds, was estimated to cost $2,466,520, exclusive of land damages, and of this sum approximately $284,500 was for bridges.

Quantities

The major quantities over the 15.2 miles of the project are:

Earth excavation	671,100 cubic yards
Ordinary borrow	784,400 cubic yards
Ledge excavation	53,200 cubic yards
Gravel borrow	245,850 cubic yards
Total material moved	1,754,550 cubic yards
Cement concrete surfacing	79,050 cubic yards

Section 1

The project starts at the easterly end at the Alewife Brook Parkway in Cambridge near its crossing of the existing Route 2 and extends northwesterly for 8,513 feet through Cambridge, Belmont and Arlington. The pavement consists of two 30-foot roadways with a 20-foot grass plot between. About one-half of this section is reinforced concrete, the other half, bituminous macadam. There are two bridges, one over the Boston & Maine Railroad and the other carrying the highway under Route 60. The estimated cost of this section was $618,000, of which $72,000 was for the bridges.

The bridge over the railroad is a 3-span structure with concrete piers and abutments and with a steel frame deck. The center span is 43 feet 3 inches skew distance, and the end spans are each 47 feet 4½ inches long. The width between fences is 78 feet 6 inches.

The bridge for the crossing of Route 60 has concrete abutments and a center pier with a steel frame deck. The two spans are 35 feet 11½ inches each and the width between the fences is 60 feet.

Section 1 is a 100 per cent Federal grant while the remainder of the sections are financed by PWA on a 30-70 per cent basis. The contractor for this section was B. Perini & Sons, Inc., of Framingham, Mass., with John Scheuren as Superintendent, and John Doherty, General Superintendent on this and all other Perini contracts on this project.

Section 2

The second section starts at the westerly end of the first and extends 16,754 feet northwesterly through Arlington, Belmont and Lexington. The pavement is 40 feet wide of sheet concrete with no separation or park space. The concrete slab is 9 inches thick, with a 7-inch base of lean concrete and a richer 2-inch top. The estimated cost of this section was $413,000, and the contractor was the Geo. A. Fuller Co. of Boston with William Godson as Superintendent.

Section 3

This section runs northwesterly from the end of Section 2 through Lexington and Lincoln a distance of 28,390 feet. The pavement is 40 feet wide of sheet concrete like Section 2. There is one bridge which carries the highway over Route 128, and which is being built by Warren Bros. Co. of Boston, Mass., with C. Allen as Superintendent, at a cost of $42,000. The bridge is a rigid frame concrete arch structure with a span of 60 feet and with a width of 76 feet between fences. The estimated cost of the entire section, exclusive of the bridge, is $655,000. The contractor for the highway is B. Perini & Sons, Inc., of Framingham, Mass., with A. Lattanzi as Superintendent.

Section 4

Extending for 3,000 feet easterly from Section 3, this Section will connect with the existing Route 2, and then it also extends westerly in Concord for a distance of 11,500 feet. The easterly extension is bituminous maca-

dam, 30 feet wide. The westerly pavement is 40 feet wide of reinforced concrete, 8 inches thick. There is one bridge over the Fitchburg Division of the Boston & Maine Railroad, estimated to cost $42,000. The estimated cost of the entire section including the bridge is $307,000. The contractor is B. Perini & Sons, Inc., of Framingham, Mass., with A. Macauley as Superintendent. The aggregate handling and paving of this section with the use of truck mixers will constitute the next two articles in this series on this Massachusetts project.

The bridge consists of concrete piers and abutments with five spans, the center span being over the tracks of the railroad and measuring 40 feet 4¾ inches. It carries a steel frame deck. The four other spans each 30 feet 9 inches long are of concrete beam and slab deck construction.

SECTION 5

The last section runs westerly and northwesterly from Section 4 in Concord for a distance of 12,100 feet. The pavement is reinforced concrete 8 inches thick and 40 feet wide with a 12-inch separation strip. This section also contains three bridges. The contractor is B. Perini & Sons, Inc., of Framingham, Mass., with A. Macauley as Superintendent. The entire section is estimated to cost $430,000 including the three bridges.

The first bridge is over the Sudbury River and is estimated to cost $64,500. It is a reinforced concrete arch structure with a granite facing. It has a skew span 84 feet long, with a thickness of 18 inches at the crown of the arch. The structure footings rest on timber piles. The width between fences is 61 feet 10 inches.

The next bridge spans the Boston & Maine Railroad and is estimated to cost $35,000. It consists of concrete piers and abutments with five spans, the center span over the tracks. The center span carrying a steel frame deck is 41 feet ½ inch long. The four other spans are each 24 feet 2⅞ inches long with concrete beam and slab decks.

The third bridge is merely a widening project for the bridge over the Assabet River, estimated to cost $29,000. The existing concrete arch is to be widened 15 feet 6 inches on the north side and 25 feet 6 inches on the south side. The span is 75 feet and the width between fences for the widened structure will be 62 feet 11 inches. The four new footings for the widened sections rest on timber piles. The arch is 16 inches thick at the crown. The grading on the fifth section will constitute the fourth and last article in this series.

The work is all being done under the direction of the Massachusetts State Department of Public Works with F. D. Sabin, District Highway Engineer, in charge.

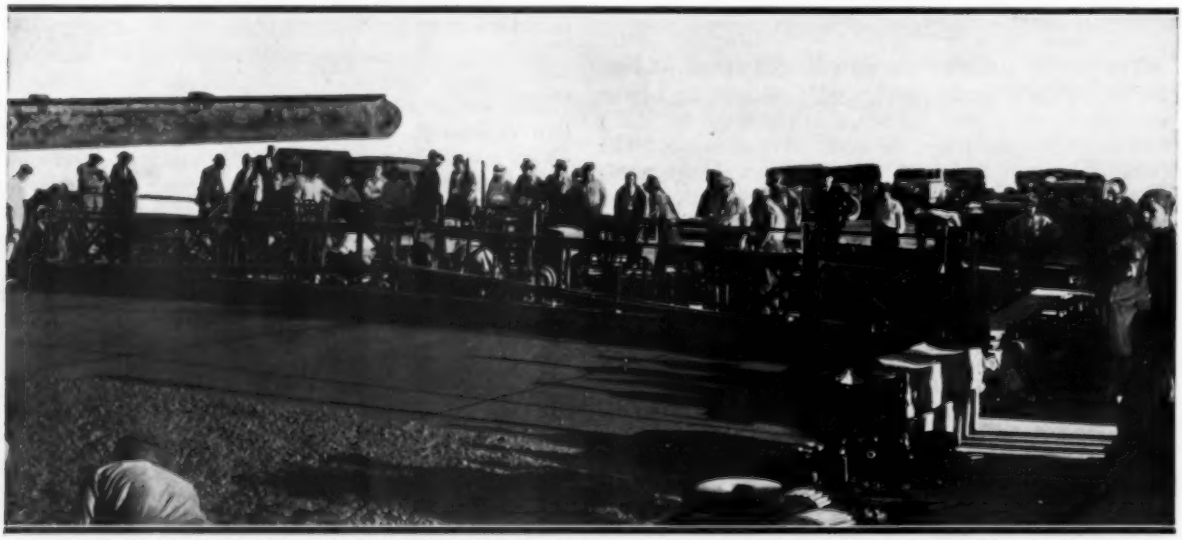
Beating the Time Schedule!

AN approximately 2-mile concrete paving job through the center of Canton, Ohio, was recently completed by the Garaux Brothers Co., of Canton, contractor for the project, four months ahead of scheduled time. The job created a great deal of local interest and was viewed daily by the hundreds of people for whom a bit of construction holds an irresistible fascination.

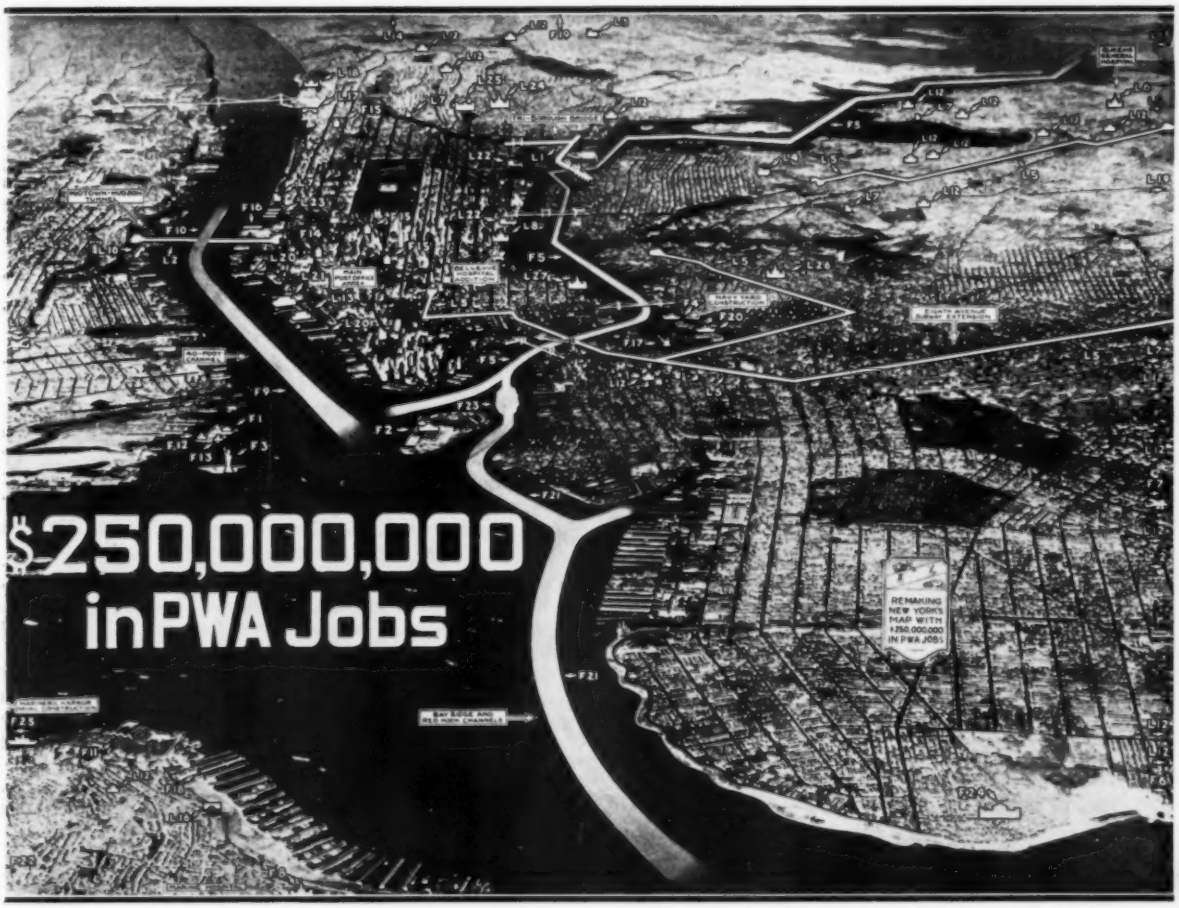
Grading was started on April 6, 1934. The roadway, which was 44 feet wide, was paved the full width in one operation, Heltzel standard road forms being used and two 27-E Multi-Foote pavers furnishing the concrete. A Heltzel finishing machine, weighing 6 tons, and 44 feet in width, adjustable to 50 feet, followed the pavers. Mounted on the finisher, directly back of the screed, were three Flex-Plane longitudinal joint installers which fed ⅛-inch x 2½-inch asphaltic ribbon, in 100-foot lengths, into the road, and transversely 44 feet across the road at intervals of 25 feet. A Heltzel longitudinal float bridge and float were used behind the joint machine.

Because of the weight of the machine and screed, it was believed that the forms would "shimmy" and tip inwardly. To avoid this, an extra track wheel was placed on each side of the machine to ride on the outside base of the forms to prevent tipping. These wheels were removed as soon as it was certain that there was no tendency either to shimmy or tip.

In spite of the adverse conditions of city paving, the street was opened on July 2, four months ahead of the schedule. The contractor reports that when the street was tested by the Ohio Highway Department, not a single bump was found. W. C. Neff, Ohio State Resident Engineer, and Luther Zerbe, County Resident Engineer, supervised this State Project No. 68 SH-66. Harry Lehman was Superintendent for the contractor.



The Extra-Width Finishing Machine Which Aided the Contractor in Completing a 2-Mile Paving Job Four Months Ahead of Schedule



THE gigantic Public Works Administration program for Greater New York, many of the projects of which are spotted on the above map, includes some of the largest engineering and construction jobs in the world. While the total program involves $250,000,000 of construction, the jobs shown on the map total $179,538,741 and will provide 1,079,328 man-months of direct employment for workers in the locality and approximately twice as much indirect employment for materials.

Projects sponsored by New York or nearby communities are designated on the photo by L, while those undertaken by the Federal Government are indicated by F. The identification of the projects is as follows:

L-1, Tri-Borough Bridge, $44,200,000
L-2, Midtown-Hudson Tunnel, $37,500,000
*L-3, Bronx "Hillside" Housing Project, $5,060,000
*L-4, Woodside, Queens, "Boulevard Gardens" Housing Project, $3,450,000
L-5, Eighth Avenue Subway Extension, $23,160,000
L-6, Queens General Hospital, $800,000
L-7, Garbage Disposal Plants, $4,000,000
L-8, Bellevue Hospital Additions, $4,978,000
L-9, Newark Airport, $22,000
L-10, Hoboken Viaduct, $136,000
L-11, Bayside High School, $2,250,000
L-12, Grade and High Schools, $2,268,500
L-13, Pier Improvements, $567,500

* Private Projects.

Uncle Sam's Aid to Employment in Greater New York

L-14, Yonkers Sewers, Water Mains and Pumping Plant, $1,074,000
L-15, Great Neck Sewers, $705,000
L-16, Grade Crossing Elimination, $460,000
L-17, Railway-Highway Crossing, $385,500
L-18, Jewish Memorial Hospital, $350,000
L-19, School, $384,100
L-20, Concrete Deck Pier, $744,400
L-21, Two-Story Shed and Relocation of Sewers, $1,282,000
L-22, Two-Pier Dumping Platforms and Sheds, $207,000
L-23, Pier Sheds, $1,193,000
L-24, Mott Haven Health Center, $185,000
L-25, Jail, $989,200
L-26, Health Center, $214,000
L-27, Laboratory Building and New Animal House, $700,000
F-1, Ellis Island, New Buildings and Sea Wall, Remodelling, $1,151,800
F-2, Governor's Island, Fort Jay, Buildings, Water System, Roads, Hospital, etc., $582,024

F-3, Statue of Liberty, Improvements to Landing Walls, Interior Lighting System, etc., $31,500
F-4, Construction of new Naval Vessels, Brooklyn Navy Yard, $4,013,000
F-5, 40-Foot Channel to Navy Yard, 35-Foot Channel to Long Island Sound, $1,456,000
F-6, Rockaway Inlet, 12-Foot Channel and Lights, $77,000
F-7, Mitchell Field Improvements, $470,858
F-8, Marine Hospital, $2,272,051
F-9, 40-Foot Channel, $100,000
F-10, Channel Widening, $656,373
F-11, Riprap Protection, $18,450
F-12, Quarantine Station, $72,180
F-13, Quarantine Station, $130,000
F-14, Main Post Office Annex, $5,143,000
F-15, Post Offices, $8,214,400
F-16, Dredging, $48,000
F-17, Navy Yard Improvements, $1,005,970
F-18, Reconditioning Ships and Pier Improvements, $387,550
F-19, Remodel Mount Vernon Federal Building, $90,000
F-20, Construction, Coast Guard Cutters, $3,718,570
F-21, Channel Improvements, $175,000
F-22 Perth Amboy Anchorage Area, $817,000
F-23, Removing Buttermilk Channel Shoal, $131,000
F-24, Fort Hamilton, Construction of New Quarters, $9,315
F-25, Construction of Navy Vessels, Mariner's Harbor, $10,050,000

Big Contractor— Big Grading Project— Little Fuss and Fast Work

(*Continued from page 26*)

the line mounted on skids. Following this and pulled by a cable from the first skid was a complete Kohler lighting plant housed in a shack built around the pole carrying a General Electric floodlight and all mounted on skids. This unit in turn pulled the grease sled and finally the tail-end sled carried a 500-gallon gas tank. This contractor uses Mobilgrease and other standard lubricants.

PERSONNEL

This contract was run in standard shifts of 10-hour days with the crews each working three days a week and was completed about the middle of November, 1934. The contractor was A. Guthrie & Co. of St. Paul, Minn., who received the award on its bid of $211,490.25. A. J. Lizee was General Superintendent for the contractor and H. H. Wolfe was Resident Engineer for the Mississippi State Highway Department.

Asphalt Paving Specifications Include Equipment

NINE pamphlets, containing the construction specifications for various types of asphalt roads, have recently been issued by The Asphalt Institute. These specifications, as they relate to surface treatment and road-mix types, show in detail the best low-cost road construction practices, as previously covered in the Institute's Road Construction Manuals. The hot-mix and penetration types are recent revisions of earlier specifications with more detailed requirements covering improved equipment.

The designating number and subjects covered by the pamphlets are as follows: A-1, asphalt macadam surface course; A-2, asphaltic concrete surface course; A-3, stone-filled sheet asphalt surface course; A-4, sheet asphalt binder and surface course; B-7, asphalt macadam base; B-8, asphaltic concrete base; S-1, asphalt surface treatment or retreatment of old bituminous surfaces; RM-1, asphaltic road-mix surface course (macadam aggregate); and RM-2, asphaltic road-mix surface course (dense graded aggregate).

Copies of these Construction Specifications may be secured without charge by readers of CONTRACTORS AND ENGINEERS MONTHLY from The Asphalt Institute, 801 Second Ave., New York City.

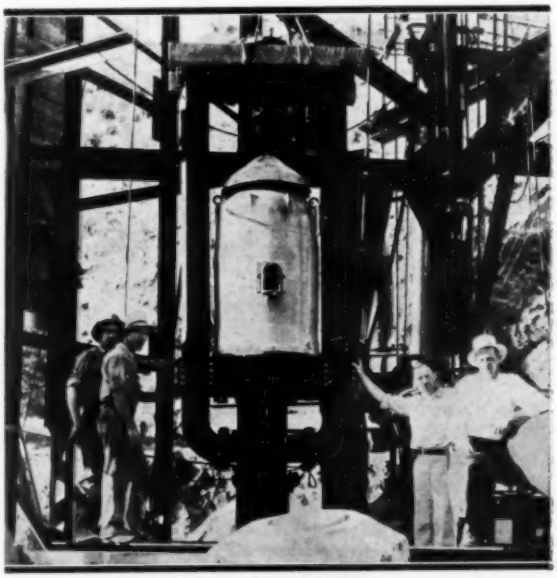
"Man the Pumps"—the Order of the Day at the Potrero Aqueduct Tunnel

ALL tunneling operations in the Potrero shaft of the Colorado River Aqueduct near Beaumont, Calif., had to cease on July 1 when the drilling crew in the tunnel struck an unexpected and unusually large underground stream or lake at a depth of 796 feet. The pressure of the water in contact with the drills was so great that it forced back through the holes in the drills and broke the air lines, flooding both legs of the bore and quickly reaching a depth of 647 feet.

In order to dewater the tunnel as quickly as possible so that operations could be resumed, Wenzel & Henock Co., contractor for the Metropolitan Water District of Southern California, sent a rush order for two dewatering pumps with direct-connected motors. As soon as possible thereafter, the pumps were shipped and the dewatering operations began on July 15.

Two Byron Jackson pumps were suspended on cables in the Potrero shaft and were operated by two 300-hp vertical hollow-shaft-type U. S. motors. The tunnel was dewatered at the rate of 1,200 gallons per minute per pump with a lift of 800 feet operating at 1,800 rpm. A third pump, a Peerless with a capacity of 2,600 gallons per minute and operated by a 700-hp motor, was later installed so that the dewatering could proceed at a more rapid rate. While pumping was under way, drying sheds were erected and other preparations made for reconditioning the mechanical equipment which had been submerged.

The Potrero shaft is part of the 13-mile San Jacinto tunnel which is one of the aqueduct tunnel units now under construction, more than 30 miles of tunnel excavation work having already been completed.



One of the Two Pumps Used in Dewatering the Potrero Shaft

The Editor Comments

Personal Observations and Reflections

"Breakdowns of Equipment"

We were in correspondence with a District Engineer of a State Highway Department a few weeks ago regarding some work underway in that territory. We quote from his reply, "We have but one contract on which concrete is being placed and that one has had too many breakdowns of equipment to enjoy much publicity."

We have apparently reached the end of the rope in using old equipment. We have seen this summer many projects where contractors were trying to stretch their equipment over just one more job and suffered severely through delays due to breakdowns. Investment in new equipment is vital to contractors' profits. It is just as important for a contractor to have a machine which will operate consistently when he is running it himself as it is when he may lease it for a period to the Federal Government under existing rental arrangements which stipulate that he will be paid for the machine for the time in which it operates according to schedule. Time out for breakdowns is, therefore, expensive on a rental proposition. It is equally expensive on your own job.

Labor Cost Increase Approaching Economic Limit

On PWA projects where there is a 25 per cent or 30 per cent grant to the city or state, the community loses the benefit of this grant when the contractor's bid is increased by that amount because of the uncertainty of "qualified labor" in the community. The contractor in general has not increased his bid because of the minimum wage requirements of PWA or the Construction Code or the limitations in hours, but rather because of the difficulty of securing qualified labor, and the time needed to try out labor supplied by the Federal Reemployment Service. The time spent in organizing the job costs the contractor money. When he adds that cost to his bids, and the cost increase approaches the amount of the grant, the Federal gift becomes of doubtful value. Costs would be lowered and contractors' bids reduced if they were allowed to bring in their own key men, which would include superintendents, general foremen and skilled operators of equipment.

There is also considerable confusion caused by the lack of uniformity or policy among FRS officials in different states and communities. One contractor was permitted to bring in his key men provided he registered them with FRS, while another in a different community was not permitted to bring in any key men and had to lose over a week of time while competent equipment operators were sought.

Dodging Gravel

In states where contractors are paid station-yard overhaul on borrow, there has developed a new racket, namely that of dodging gravel pits. In one state where gravel is plentiful, and is used for the foundation course, there is a 2,000-foot free haul clause in all contracts. State engineers have found that there is a tendency to skip pits within the free haul distance and to secure options on other pits which will produce income on a station-yard overhaul basis.

In order to eliminate pits within the free haul distance, a contractor may have connived with the owner, through payment, to have him refuse to open the pit, or he may have argued with the owner that the potential value of the site for real estate was greater than the immediate income from the sale of gravel which might ruin the future real estate sales value.

It has become necessary for state highway departments to spend more money in examining pits and securing options on them to eliminate this growing tendency to step up income by longer hauls. It is unfortunate that some contractors have stooped to such practices.

How Fast Do You Drive?

At a recent informal meeting of Harvard engineers, Professor Charles J. Tilden of the Yale Engineering School told of his 85,000 observations of traffic speeds with a simple peek-a-boo periscope. He reports that most folks drive in the 40-48 mile-per-hour class and that less than 5 per cent of us are in the 60-70 mile-per-hour class. He finds that motorists driving alone operate their cars at much higher speeds than when they have passengers. All of his observations were made in Connecticut.

He should clock some of our contractor friends from Kentucky and the middle west when trying to get a week-end at home by driving all night or when setting off hot foot for repair parts. That 5 per cent would be stepped up to a much larger figure!

Theodore Reed Kendall

Legal Points for Contractors

These brief abstracts of court decisions in the contracting field may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt consult your own attorney

Edited by A. L. H. Street, Attorney-at-Law

Tampering With Wording of Contracts Annuls Whole Agreement

The contractor who is tempted to interline or strike out some word or provision in a note or contract held by him, without the knowledge or consent of the other party, had better not do it. The contractor may assume that the only risk he takes in doing this is that the other party will challenge the alteration, without jeopardizing the contractor's rights under the agreement as originally worded. But that is not true.

It is well settled law that *one may claim complete release from a contract that has been altered in a material respect and without his consent by the other party.* And this rule applies to checks, notes and other commercial instruments, as well as contracts in general.

The law is so drastic that a fraudulent alteration of a note not only enables the maker to repudiate the note, but also the debt on which the note was founded. The reason for this rule is that if a person altering an instrument receives the benefit of the chance of "getting by" with it, he ought to be good enough sport to take some greater adverse chance than merely being driven back to the contract as mutually worded. By facing him with the risk of losing all his rights under the contract, as a penalty for fraudulently tampering with the writing, it is thought that he may be induced to refrain from such action.

Even when there is no intent to defraud, the safe rule to follow is: Do not make any change in the wording of a document without the assent of the other party. And see that the change is made in the other party's copy of the contract, so that he cannot afterwards deny that he assented, which he plausibly could do by producing his copy of the contract not showing the change.

Public Contractor Exonerated from Liability for Incidental Damage to Abutting Property

"We want damages resulting from your raising the street grade," demanded abutting property owners of a street improvement contractor in Texas. "You have changed the course of flowage of surface water."

"Sorry, but I'll have to refer you to the city," replied the contractor.

The abutting property owners' lawyers seem to have gotten mixed as to the law of the case—probably confusing the situation with instances in which public contractors have been held liable for injuries resulting to outsiders from negligent performance of a contract, or violation of its terms. In the ensuing lawsuit, the contractor won out. Said the Texas Court of Civil Appeals (Russel v. General Construction Co., 59 S. W. 2d, 1109):

"The city being within its legal right in making the public improvement, and the * * * construction company having properly done the work, according to the plans and specifications, there would be no liability for damages against the company, though the street was elevated above the defendants' property and cast water thereon, contrary to the natural flow of the same. The work of the construction company was not its personal act, but that of the city of Merkel, which, under definite conditions, was liable for damages, if any, flowing from the act complained of."

When Contractor Is Entitled to Pay for Work Not Done

"For $16,000 we will do all the concrete work that you are required to do under your general contract with the railway company," said subcontractors to a firm which was constructing shop improvements for the railroad.

"You're on," replied the general contractor.

As sometimes happens, the plans and specifications were not clear as to just what work was to be done. It was doubtful whether tracks outside a shop building were to be laid in concrete, or merely those inside the building. The railroad company did not try to take advantage of the point, conceding that no concrete work was required outside. The job was finished under this interpretation of the plans and specifications, and the general contractor collected the full amount of the agreed contract price. But they balked on paying the subcontractors the full amount of their price, on the ground that they had been spared the necessity for laying in concrete tracks outside the shop. Nearly $2,000 was involved.

The Virginia Supreme Court of Appeals decided (Fix v. Craighill, 169 S. E. 598) that the subcontractors were entitled to the full contract price, because it was fixed under mutual doubt, as between the general contractor and the subs, as to just what was required by the plans and specifications. Said the court:

"When parties treat on the basis that any material fact which is the subject of the agreement is doubtful, and the consequent risk which each is to encounter is taken into consideration in making the contract, one party is not entitled to be relieved from the contract because it turns out that the facts about the matter with reference to which they were in doubt are to the advantage of the other party. Mistakes as to matters which the contracting parties had in mind as possibilities and as to the existence of which they took the risk are not such mistakes of fact as entitle either party to relief."

Who's the "Goat" When the Weather Spoils Work?

Mr. Auerbach—whoever he may be or may have been—at one time remarked, "We consider it tedious to talk of the weather, and yet there is nothing more important." Weather may be so important to a contractor on almost any job as to be worth taking into account on every bid that is made.

These remarks are prompted on reading the decision of the Washington Supreme Court in the case of Knickerbocker Co. v. Gjarde, 22 Pac. 2d, 987.

Building plans and specifications were such that concrete floors had to be poured as each level was reached. This meant no protection to the floors from weather, excepting as specially provided by the contractor. A series of rainstorms played hob with the third floor. The contractor tried to remedy the defects, but failed. Thereupon the owner had this done.

Finding that the contractor was liable for the cost, the court decided: By taking a contract in August for a building to be completed by January, the contractor took upon himself incidental weather hazards. Two attempts to correct the defective work impliedly admitted that he was responsible for the defects. The contractor was liable for loss of use of the building pending correction of the defects, he having been informed as to the use to which the building was to be put.

The Face of the Heading and the Liner Plates and Breastwork in Place During the Placing of the Concrete Lining

Tunnel Driven Without Shield

Liner Plates Carried Tight Against Face

A SMALL compressed air tunnel was successfully driven recently under the Passaic River at Newark, N. J., without the use of a shield. Truscon steel liner plates were used for the outside lining, the plates being carried tight against the face, with the top segments extended ahead to form a hood when excavation was in progress. The concrete lining, which was placed by hand, was carried close to the heading.

The tunnel, 8 feet in outside diameter and 588 feet long, with a 12-inch unreinforced concrete lining, was driven from two shafts about 50 feet deep. It is a power line conduit, designed to carry 44 cable ducts. The duct lines were not installed until the tunnel driving was completed and air taken off. The ducts, cement asbestos tubes, are racked on both sides of the tunnel and are completely encased in concrete, leaving an open passageway 28 inches wide through the center. Twelve of the ducts, for high tension lines, are 4½ inches in diameter and the remainder are 3½ inches.

The tunnel, which is part of the Pennsylvania Railroad's Newark improvements, skirts the north ends of four piers of a new three-track lift bridge now under construction. To keep the west shaft of the tunnel within the railroad right-of-way, and still clear of the west pier of the left span of the new bridge, required a curve of nearly 8 degrees near the west end of the tunnel. The grade of the tunnel is uniform, pitching downward 0.5 per cent eastward.

The tunnel was built under the direction of A. C. Watson, Chief Engineer, New York Zone; T. W. Pinard, Engineer of Bridges and Buildings and L. P. Struble, Engineer of Construction, Pennsylvania Railroad. Charles S. Landers, New York City, was Consulting Engineer on the tunnel and bridge foundations. J. Rich Steers, Inc., New York, was the contractor for much of the improvement work and sublet the tunnel to Senior & Palmer, Inc., New York. James F. Armstrong was Superintendent in charge of the tunnel construction and John Malcolm was Superintendent for J. Rich Steers.

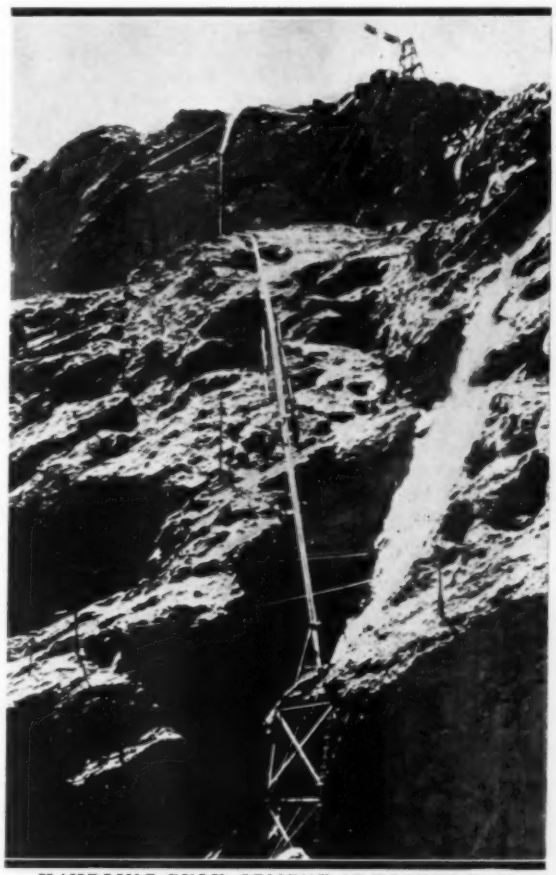
Protect the Eyes!

RECENTLY a man working at an emery wheel who was wearing a coverall safety goggle over his glasses was asked how he happened to be using it. He said: "I ruined a $10 pair of spectacles before I began to wear them. The hot sparks of the emery wheel burned the soft glass of the spectacle lens."

When asked if he wore safety goggles before he wore glasses, he said "No." That man was willing to protect a $10 pair of glasses but never thought it necessary to protect a pair of eyes, which no money on earth can replace.

There are many phases of work on construction jobs where the protection of the eyes is most important. Men working in the vicinity of arc welding operations need a specially tinted optical glass to prevent burned eyes, and the selection of a proper protective lens for the welders is obviously important. Riveters, reamers, rivet heaters and others frequently get hot scale or cinders in their eyes, which often results in the formation of an ulcer with an ultimate result of loss of sight. Special coverall goggles should be worn by such workers. Men using emery wheels, or chipping brick, concrete or rock should be protected by a fully-enclosed cup type of safety goggle. The spectacle type of goggle offers no obstacle to particles flying from the side. Truck drivers usually need protection from dust and from glare.

The expenditure for safety goggles is trivial compared to the cost in money and mental anguish of the loss of sight.



HANDLING BULK CEMENT AT HOOVER DAM

Dry cement is conveyed from the upper to the lower mixing plant by means of this 3,500-foot Lindewelded line of 9-inch pipe. At one point in the line there is a drop of over 1,000 feet.

How the Other Fellow Did It

Ideas That Have Already Proved Helpful to Contractors

Have You a Real Service Truck?

335. On every job there are one or two service trucks, usually 1½-ton affairs with an ordinary delivery body or flat bed, which handle the innumerable small items which have to be moved about. On highway work they frequently handle the forms in the morning as an essential part of their duty. A Pennsylvania contractor maintained two service trucks which he called "roustabout" trucks, and used them for hauling burlap, forms, reinforcing mesh and the other thousand and one items to be moved. One of these was of particular interest as it was equipped for special service, and was run only by the master mechanic. It contained the necessary tools for quick repairs and adjustments to machinery on the road. It also carried lanterns, and a complete electric generating outfit which could supply current for electric lights for late finishing on a concrete job or for night repairs to any piece of equipment. Two 3-foot diameter spools of wire with the light sockets in place were carried on the back of the truck. The generator was powered by a separate engine. 27.5.24

Hillside Plow Helps Earth Curing

336. Where earth curing is used for concrete slabs, contractors frequently use the rooter plow along the shoulder to loosen the dirt for easy hand shoveling. One contractor uses a hillside plow for this purpose. This kind of plow is built with an unusually long wing which can be unlatched and turned over quickly to throw the earth to the other side. Thus, the wing can always be set to throw the dirt toward the edge of the slab, no matter in which direction the plow is going. 27.3.19

Paving With Industrial Railway Haulage and Infrequent Switches

337. A Michigan contractor handling a contract along the shores of Lake Michigan was unable, because of the nature of the right-of-way, to install industrial railway switches except at very infrequent intervals. This resulted in delays of an average of 10 minutes an hour at the paver, waiting for the next train to come up. This was overcome satisfactorily by sending up a double header of two trains. The first extra train was sent up before work started in the morning and kept on the track ahead of the paver, serving only for the time an empty train was on the way from the paver back to the last switch and the next full train came up. When the extra train was empty it went down to the plant for restocking. It was usually nearly noon when this was necessary so that the scheme overcame the trials caused by infrequent switches. Ten-car trains were operated throughout this work, and 2 miles of track was maintained at all times. 27.4.12.

An Easily-Moved Rock Channeling Outfit

338. On a large lock operation the contractor devised a rock channeling outfit which was most interesting and effective. A structural steel frame was mounted on a crawler truck with four drills on one side and one drill at each of the other corners. The four drills on one side were used for channeling and, by moving the crawler trucks ahead 3 inches, the holes could be drilled on 3-inch centers four at a time. The four corner drills were used for ordinary drilling. In channeling, the holes on this job were drilled 8 feet deep, using 1¼-inch steel, and blasted with 70 per cent gelatin dynamite. 27.6.16

Relaying Bulk Cement to a Floating Mixing Plant

339. During the construction of one of the dams in the Allegheny River near Pittsburgh, the contractor employed a floating mixer plant mounted on a 40 x 90-foot steel barge equipped with four spuds installed within the hull where they could not be damaged nor damage other equipment. Inasmuch as the dam was constructed for several hundred feet in shallow water, a slackline cableway was used to dredge out a channel for the barge. Bulk cement was delivered in special cars on a spur track high above the north shore end. For the initial work on the first 400-foot section of the dam the bulk cement was pumped direct with a portable cement pump from the cars down the slope of the railroad fill through a 4-inch flexible rubber pipe to a 500-barrel bulk cement tank on the floating mixing plant. An auxiliary cement tank of 600-barrel capacity was installed on another barge so that when the floating mixer plant was operating too far from the shore to permit direct pumping the portable pump could be mounted on the auxiliary barge and the cement pumped from the barge to the tank on the plant while it was in operation. 27.6.18

Large Squares of Canvas Save Many a Heartache

340. An Ohio contractor carried a goodly supply of 20 x 20-foot canvas with eyelets and ties on his job as protection against too quick setting of the concrete or damage from heavy showers. The canvas could be quickly laid over the slab at such times as a breakdown which might cause the finishing machine to lag behind the paver. Or if one of those quick and severe thundershowers, for which the middle west is well known, came up, the slab could be protected while the men took shelter until the downpour passed. 27.5.24

Railroad Spikes Hold Forms on Sand Asphalt Work

341. On a Massachusetts sand asphalt job where 2 x 4's laid on the grade were used as the forms during the spreading of the base course, the contractor held them in place with three railroad spikes for each 12 to 16-foot length of 2 x 4. Railroad spikes were used rather than short sections of iron or steel rods or dowels because the spikes can be easily removed by a grub when the forms are removed because of the wedge shape of the spikes. Also spikes can be used over and over and even if a few are lost each time, they are cheap enough to warrant replacing them. 27.6.24

An Automatic Track Sander for Steep Grades

342. After he had several runaways on a steep grade which had to be descended by loaded industrial trains, a midwest contractor devised an automatic sanding device which proved very effective. He set up between the 36-inch gage rails frames about 33 inches wide and about 6 feet long made up of 2 x 4's. These were filled with sand slightly heaped up so that the axles of the cars would knock the sand from the frame onto the rails or into the slots between the frame and the rails where it would be effective in sanding the rails and wheels. About ten of these frames were inserted on the downgrade, 25 feet apart, and entirely prevented any further difficulty from slippery tracks. 25.5.17

A P&H Shovel Loading Rock at the New Jersey End of the Midtown-Hudson Tunnel

Work on New Midtown-Hudson Tunnel Gets Under Way

WORK on the long delayed tunnel under the Hudson River, extending from midtown Manhattan to Weehawken, N. J., has been begun by the Port of New York Authority. Although the project will ultimately consist of two tubes with one-way traffic in each, to take care of the increasing traffic volumes from the mid-section of New York City, present plans call for a single tube about 8,000 feet long with a two-lane roadway to carry traffic from the vicinity of 38th Street and 10th Avenue to New Jersey.

Built by the shield-driven method in silt, the greater part of this tunnel will consist of cast iron rings built up by bolting together segmental castings. The interior arrangement will be similar to that of the Holland Tunnel but with a wider roadway of 21½ feet and a clearance of nearly 14 feet. Except for a grade of 4 per cent at the extreme east end, the maximum grade of the tunnel will be 3.5 per cent, the lowest point of the tunnel to be 70 feet below mean low water level.

To provide space for the ventilation buildings on the Jersey side, it is necessary to excavate an area approximately 200 feet long and 50 feet wide, the entire height of the rock palisade which rises abruptly from the river's edge. With a large group of buildings atop the cliff and the tracks of the New York, Ontario & Western Railway at the bottom, work is hampered due to the necessity for light blasting. George M. Brewster & Son, subcontractor under the Silas Mason Co., is using P & H equipment on this work.

Progress on Public Works Highways

There are 2,776 *projects under construction from the Public Works funds provided by the Acts of June* 16, 1933, *and June* 18, 1934. *These involve* 7,881 *miles of road and are giving employment to* 173,159 *men. There are* 594 *projects approved on which contracts have not been awarded,* 507 *projects awarded but not yet under construction and* 6,010 *projects completed.*

Road Builders to Meet in Washington

THE thirty-second annual convention and exhibit of the American Road Builders' Association will be held in Washington, D. C., January 22-25, 1935. The headquarters of the convention, and the exhibit, will be at the Willard Hotel. Since the organization of the Association 32 years ago, it has taken the leadership in the cause of "good roads" and this convention provides the opportunity for all interested to co-operate in furthering its good work.

The theme of the convention, announced by Capt. H. C. Whitehurst, President of the Association and Director of Highways, Washington, D. C., will be the continuation of an adequate highway program; the use of highway revenues for highway purposes only; and the continuation of Federal appropriations for highway construction. The recommendations and conclusion growing out of the convention sessions will be of inestimable value, not only before Congress in national legislation, but will serve as a guide to the forty-four state legislatures which will convene in 1935.

An entire session will be devoted to a symposium on gasoline tax and motor license fee divisions. There will be two general sessions to deal with the general subjects, and there will also be sessions of the County Highway Officials' Division, City Officials' Division, Highway Contractors' Division, and Engineers and Officials' Division, to present and consider the subjects directly applicable to these divisions. In addition to the divisional and general sessions, there will also be meetings of several of the committees and of the Road Builders' Advisory Council, for the purpose of formulating an organized plan to be used in returning to the highway program the $200,000,000 which is now being diverted from gasoline tax and motor license revenues.

Tuesday evening will be devoted to the Pan-American reception, where a program on Mexico and the international highway in Mexico will be presented. On Thursday evening, the Road Builders' banquet will be held, at which a speaker of national prominence will deliver an important and interesting address.

There will also be, in conjunction with the convention, the annual Highway Exhibit where the latest developments in equipment and materials will be presented for the inspection of all those interested in the highway industry and profession.

Construction Industry News

American Hoist & Derrick Co., St. Paul, Minn., has announced the resignation of Frank J. Johnson as President. Mr. Johnson, with Oliver Crosby, founded the American Mfg. Co. in 1882, manufacturing hand power hoists and derrick equipment. The company was reorganized in 1892 and became the American Hoist & Derrick Co., with an enlarged line of hoisting and earth moving machinery, including power hoists, steel derricks, locomotive cranes, shovels, the Crosby wire rope clip and similar items. Frederic Crosby, son of one of the founders, succeeds Mr. Johnson. Howard S. Johnson, son of Frank J. Johnson, will continue in his present position of Vice President and Harold O. Washburn, formerly General Superintendent, has been appointed Vice President and Treasurer to succeed Mr. Crosby.

Harnischfeger Corp., Milwaukee, Wis., has announced the appointment of W. W. DuPre, successor to the Thomas W. Brown Co. of Towson, Md., as its representative in the State of Maryland for P & H excavators ranging from ⅜ to 4 cubic yards capacity.

Baldwin Locomotive Works, Philadelphia, Pa., has announced that Daniel B. Worth, Chief Engineer of the Whitcomb Locomotive Co., has joined the Engineering Department and will be engaged with the engineering of Baldwin and Whitcomb electric and internal combustion locomotives. Edward P. Hachtel, Whitcomb Production Engineer, will remain at Rochelle where he will be in charge of inspection.

Allan Beach, Advertising Manager of Littleford Bros., Cincinnati, Ohio, manufacturer of road equipment, was elected for the second time to the position of Secretary-Treasurer of the National Industrial Advertisers Association at its conference in Cincinnati in September.

Bucyrus-Erie Co., South Milwaukee, Wis., has announced the appointment of three new distributors for Loadmaster cranes: Ray Corson Wilkins Co. of Denver, Colo., for the State of Colorado; Irving G. King & Co. of Los Angeles, Calif., for the Los Angeles territory; and H. A. Stevenson, 7310 Woodward Ave., Detroit, Mich., for the Detroit territory.

Novo Engine Co., Lansing, Mich., has announced three new distributors for Novo products. They are Van Nouhuys Pump & Supply Co., 131-133 Hudson Ave., Albany, N. Y., for Albany, Schenectady, Rensselaer and Columbia Counties in New York State; Metalweld, Inc., 26th & Hunting Park Ave., Philadelphia, Pa., for Eastern Pennsylvania, Southern New Jersey and New Castle County in Delaware; and The Motive Parts Co. of America, Inc., 2419 Indiana Ave., Chicago, Ill., for the Chicago territory.

Columbia Alkali Corp., Barberton, Ohio, recently opened its new alkali plant in Corpus Christi, Texas, where for the present heavy chemicals, including soda ash and caustic soda, will be manufactured and stocks of modified sodas, special alkalies, detergent, and flake and solid calcium chloride will be carried for distribution. Later a number of special products will be manufactured there for the Southwestern territory. Attractive brochures announcing this new plant, which will operate as the Southern Alkali Corp., have been distributed by Columbia Alkali Corp. to its customers and friends.

Link-Belt Co., Shovel and Crane Division, Chicago, Ill., has announced the appointment of the Allegheny Equipment Corp., 1218 Grant Bldg., Pittsburgh, Pa., with a warehouse at Bradford, Pa., as a distributor for Link-Belt crawler shovels, cranes, draglines and locomotive cranes. T. F. Ruane will handle this account.

Reo Motor Car Co., Lansing, Mich., has announced that arrangements have been completed with the Mack-International Motor Truck Corp., to sell and service Reo Speedwagons and trucks in the following cities: Brooklyn, Oklahoma City, Louisville, Tulsa, Omaha, Memphis, Akron, Erie, Baltimore, Chattanooga, New Orleans and Seattle. Complete displays of Reo's new 1935 Speedwagons will soon be announced in those cities and complete parts and service facilities will be maintained by the Mack Corp.

Socony-Vacuum Oil Co., Inc., New York City, has announced a new method of refining lubrication oil. This Clearosol Process uses powerful solvents to wash impurities out of the oil. The oil produced minimizes carbon forming in an automobile engine and it eliminates crude oil tar, gum and sludge to a degree heretofore thought impossible, according to the refiners. Oil made by the Clearosol Process has been tested in different makes of cars in more than 100,000 miles of actual driving and it is reported that it stands up 25 per cent longer.

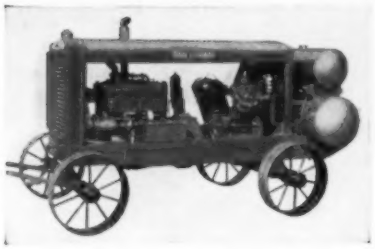
Koehring Company, Milwaukee, Wis., has announced the appointment of the Cramer Machinery Co., 706 Lewis Bldg., Portland, Ore., as distributors for the sale of Koehring shovels, cranes and draglines, mixers, Dumptors and mudjacks in the state of Oregon; and also the appointment of the Midland Implement Co., Inc., 2300 Montana Avenue, Billings, Montana, as Koehring distributors for southern Montana.

Research Stops Exuding Joints on Brick Roads

IN December, 1933, the National Paving Brick Association, Washington, D. C., established a Research Bureau at the Engineering Experiment Station of Ohio State University to investigate the best utilization of vitrified brick in the design and construction of pavements. The research work to date has been principally in connection with joint fillers used in brick pavement construction with a view to developing a material that will be more non-exuding in character than the bituminous filler now in general use. Laboratory tests simulated service conditions with brick pavements, having joints filled with various materials, constructed in panels and subjected to electrical heat on a definite schedule.

The tests warrant the conclusions that the exuding of filler can be practically eliminated by the use of a blended asphalt with a high melting point. A type of plastic sulphur also proved to be suitable. By the addition of mineral matter to bituminous cement, exuding can be materially reduced. The reduction of exudation of fillers has assumed especial importance since the removal method of filler application with vertical fiber lug brick has demonstrated by actual tests that it will produce a surface with anti-skid characteristics.

The program to check the laboratory findings has been completed. The more promising filler materials will be included in the construction of experimental sections in a brick pavement and the results in service observed. The National Paving Brick Association plans to continue to maintain its Research Bureau with a view to extending the usefulness and value of brick as a paving material. The work is under the general supervision of Dr. G. A. Bole, Research Professor at the Ohio State Experiment Station and Dr. W. C. Rueckel, Research Engineer, is in direct charge. George F. Schlesinger, formerly Ohio Highway Director, is Engineer-Director of the National Paving Brick Association.



The New Type WK 60 Portable Air Compressor

A New Two-Stage Portable Air Compressor

A NEW portable air compressor, of two-stage design of the angle or V type with the air end air-cooled, has recently been announced by the Sullivan Machinery Corp., 400 No. Michigan Ave., Chicago, Ill. The design of this new model, known as Type WK60, reduces fuel consumption which, it is claimed, is also decreased by a new Wafer valve of large port area and very low lift. The air ports and air piping are designed to provide minimum resistance to air flow. The base of the compressor is of welded resistance steel. The main bearings are of the ball type and the number and weight of all reciprocating parts have been reduced to a minimum.

This new model, which is available in four sizes with any kind of mounting, two or four-wheel, steel tires or either kind of rubber tires or mounted on a truck, is powered by the same kind of heavy-duty industrial engine which has been used in previous models of Sullivan compressors. It is also provided with all modern compressor and engine accessories such as air cleaners and oil filters.

Auxiliary Roll Makes Smooth Road Surfaces

HIGHWAY engineers are agreed that proper compaction is a most important factor in obtaining long service from paving and they require roller equipment which will produce greater and more uniform compaction and a perfect level on the paving surface. The new Hercules Ironer Roll, recently announced by Hercules Co., Marion, Ohio, as an attachment for its three-wheel rollers, is designed to meet these requirements.

This Ironer Roll is an auxiliary roll of small diameter, mounted in place of and interchangeable with the scarifier. It is hydraulically-operated, roller bearing mounted, and has great flexibility in its operation, having a range from 6 inches below to 6½ inches above grade. In operation, a weight corresponding to more than 50 per cent of the total weight of the entire roller may be exerted on this auxiliary roll and, as the small diameter of the roll provides a shorter arc of contact with the material being rolled, better compaction is obtained,

The Hercules Ironer Roll Attached to One of Its Three-Wheel Rollers

high spots are eliminated and a uniformly level surface obtained. Positive power control automatically maintains proper traction on the rear driving wheels at all times.

Placing this auxiliary roll at the rear of the Hercules three-wheel roller, a true plane about 17 feet in length is obtained. This long plane surface eliminates short waves in the road surface which ordinary rollers do not always eradicate. It is claimed that this auxiliary roll requires less rolling on the job and eliminates the necessity for cross rolling entirely. This last feature is especially desirable where it is necessary to maintain traffic during construction as a single traffic lane may be repaved in this manner without obstructing the second lane.

Convertibility with Fewer Changes Feature of New Shovel

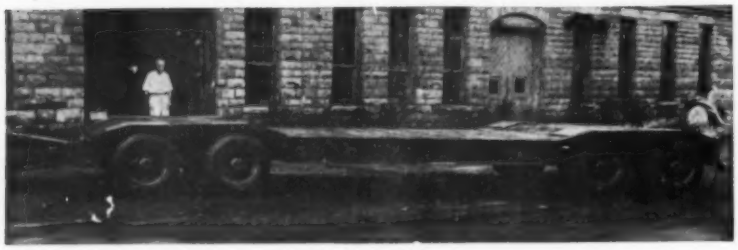
ONE of the several features of the new Victor Special 1½-yard shovel recently announced by the Osgood Co., Marion, Ohio, is its easy convertibility from one class of service to another without the necessity of any machinery changes. All that is needed is to change the front end equipment, which can easily be done in the field, within the space of two hours. Another feature of this new unit is that almost any combination of line speed and line pull can be provided to suit the user's particular needs.

The New Osgood Victor Special

On the Victor Special, all the operating machinery lies well back of the center line of rotation, designed for balance and allowing it to lift its required and stated load with the use of the least possible amount of counter-weight. The upper revolving body and the lower body and roller path upon which the machine rotates and the side frames which carry the continuous tread or crawlers are all of one-piece steel castings, titanium-treated and thoroughly annealed. The crawler treads are of manganese steel alloy joined one to the other with lugs having seven points of contact and special alloy steel pins. Gasoline, diesel or electric power is available. Transmission from the power units to the machinery proper is by means of a heavy silent chain, a drive which provides elasticity and works with the least friction.

Steering is under full control of the operator from his position at the levers. Protection for the operator and a full view of his work is afforded by glass windows in steel frames and the construction of the steel cab which is cut back on the opposite side, to afford clear vision. A running board is also provided. The assembly of machinery and means for lubrication and adjustment are designed to maintain the machine's operating efficiency with the minimum amount of effort on the part of the operator.

As a shovel, the Victor Special carries a steel boom of the inside type, heavily diaphragmed throughout its length, an outside dipper handle and full manganese dipper. As a crane, dragline or clamshell unit, it is furnished with a boom of the required length to meet the user's needs.



The LaCrosse Tu-Way Trailer Equipped with Pneumatic Tires

New Heavy-Duty Trailers Mounted on Pneumatic Tires

A FEATURE of the new low-cost heavy-duty LaCrosse Tu-Way trailer, recently announced by the C. R. Jahn Co., 760 Polk St., Chicago, Ill., is the new pneumatic tire, developed especially for such heavy-duty units, with which it is equipped. These tires have a diameter of less than 30 inches, a capacity of 3,600 pounds and are 10-ply.

The loading platform of this new trailer is less than 30 inches from the ground, permitting easy loading over the ends as well as over the sides. The wheels are sturdy and stocky, mounted on Timken bearings and have demountable rims. In addition to these features, the LaCrosse Tu-Way trailer has retained all of the standard features of former models. They can be towed from either end, loaded from either end and the side, steer from either end and have eight-wheel brakes.

A New Series of Motor-Truck-Mounted Cranes and Shovels

A NEW series of cranes and shovels designed for mounting on motor trucks has recently been announced by the Universal Crane Co., Lorain, Ohio. These are known as the Universal-Lorain 40, 37 and 30, and have crane lifting capacities of 8½, 7¾, 7½, 7 and 6½ tons at a 10-foot radius. Crane booms are 25, 30 and 35 feet in length and may be equipped with straight boom tip extensions 5, 10, 15 and 20 feet long to afford a maximum 55-foot boom. Gooseneck extensions of 5 and 10 feet are also available.

The shovel boom is a full shipper shaft type, rope crowd, of the same design as used on the crawler machines. Dippers are furnished in ¾, ½ and ⅜-yard sizes.

The units are full-revolving, one-man operated and powered by 6-cylinder gasoline engines. They are built to the Thew center-drive principle, enabling the unit to lift 6½ to 8½ tons, with a total turntable weight suitable for mounting on 5 to 7½-ton motor trucks of standard makes.

New Scale Records and Prints Weight

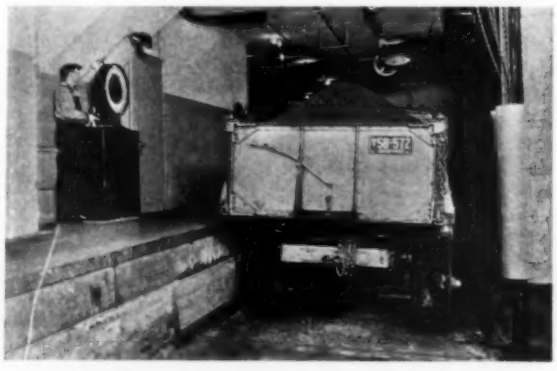
THE accurate weighing of loads and batches is a matter of great importance to both the contractor and the state, city, town or private owner for whom the construction job is being done. The human element, upon which has depended the accurate recording of the weight registered on the scale, has resulted in many errors in reading the weight, remembering and recording it. Poor light, faulty eye-sight, haste or negligence have often caused errors which led to trouble and loss of profits. Even when the weight is properly read and remembered, there is still the chance of errors because of illegible or transposed figures or any one of the careless mistakes with which accountants are familiar.

The new Toledo Printweigh, a precision device which is designed to make the recording of weights as accurate as the weighing itself, by printing on slips of paper which are readily detached for future reference the weights registered on the scale, has recently been announced by the Toledo Scale Co., Toledo, Ohio. This Printweigh, which is available in any weight capacity from 50 to 50,000 pounds, is a simple mechanism, electrically-operated, and may be used with any Toledo automatic dial scale, including those already in use. In place of the scale indicator, there is a light-weight aluminum-alloy disc, weighing no more than the indicator itself and imposing no burden on the weighing mechanism. The weights are printed from a row of raised figures, located on this disc. The ticket or paper strip is placed between the printing disc and the squeeze platten; the inked ribbon, between the ticket and the platten. The printing ribbon is automatically fed and rewound. At the touch of the operating button, the back platten and squeeze platten come together. Printing is positive and instantaneous, with no delay whatever, and the printing door can be locked for protection against tampering.

The Printweigh is flexible in its application. Single tickets may be printed or a continuous strip record may be made. Double or triple strips may be used, or where it is desirable to have the weight recorded on single tickets and a duplicate recording on a continuous strip, this is also possible.

The electric operating control button is usually placed in an accessible position on the scale, but it can be located at a remote point, entirely away from the scale, as inside a contractor's office or storehouse. The Printweigh can easily be adapted to any type of current.

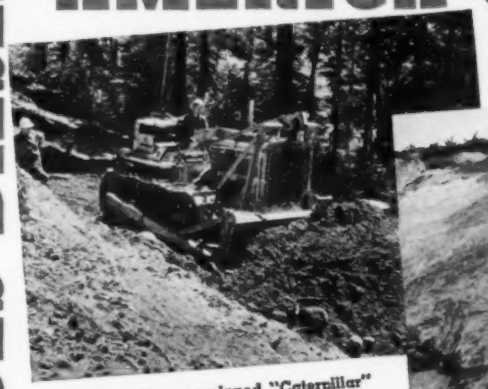
An important auxiliary feature is the selective numbering device, which permits the printing of a number or symbol, in addition to the weight, providing positive identification of each weight. Another method of identifying Printweigh figures is provided by the weigh identifying device, by which abbreviations of names or materials can be used to identify particular loads.



A Heavy Load of Road Material on the Scales While the Operator Pushes the Button of the Printweigh for the Batch Ticket

AMERICA GOES DIESEL

•AMERICA GOES DIESEL•



▲ This bulldozer-equipped "Caterpillar" Diesel Seventy-Five Tractor supplies low-cost, dependable power to Contractor Clarence Young for a mountain road building job near Butte Meadows, California.

▼ This is one of three "Caterpillar" Diesel Seventy-Five Tractors on Mr. R. Roland's contract at Coulee Dam. Working 20 hours per day. Moving 11 to 12 yards per trip. Fuel cost is only about 30 cents per hour.

◀ Pulling a "Caterpillar" Elevating Grader, this "Caterpillar" Diesel Fifty Tractor is doing canal construction work for the Irrigation Department of the Union of South Africa.

•AMERICA GOES DIESEL•

AMERICA GOES DIESEL

"SO WE INCREASED OUR FLEET OF 'CATERPILLAR' DIESEL TRACTORS"

—SAYS H. W. McKINLEY, GLENDALE, CALIFORNIA, CONTRACTOR, AFTER HIS COST RECORDS SHOWED THAT THREE BIG "CATERPILLAR" DIESEL TRACTORS WERE COSTING LITTLE MORE FOR FUEL THAN ONE 30-HORSEPOWER GAS TRACTOR.

Another southern California contractor, Clarence Crow, of Crow Brothers, writes: "Our fuel cost for each of our 'Caterpillar' Diesel Seventy-Five Tractors is only one-fifth of what it used to be for our big gas tractors."

Other owners, everywhere, report similar results. Says E. B. Boyle, President of the Boyle Road and Bridge Company of Sumter, S. C.: "Fuel for the 'Caterpillar' Diesel costs us less than 1/3 the cost of fuel for a gas machine of the same size." From Pickering, Mo., Mr. L. O. Killion writes: "Ten to twelve gallons of fuel is driving the Diesel Thirty-Five the same number of hours that 25 gallons of gasoline did the gas 30-h. p. tractor, besides doing one-half more work."

More work—less cost—such are the results reported by the thousands of enthusiastic owners of "Caterpillar" Diesel Tractors and Power Units. That explains why more and more users of tractors and stationary power are going Diesel—with "Caterpillar." Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

Surface Vibrator for Double-Screed Finisher

SOME very interesting experiments in the use of vibration for concrete roads have been made recently and very satisfactory results have been secured. Vibration for concrete roads is becoming more and more accepted and will very likely be a part of the work of laying all concrete roads in the future.

A vibrator attachment for this purpose, which is designed for use with its 20-foot gas-electric road finisher, has recently been announced by the Blaw-Knox Co., 2067 Farmers Bank Bldg., Pittsburgh, Pa. The attachment consists of two independent 10-foot units, each operated with an independent motor drive. Each of the vibrators is equipped with two vibrating elements, making a total of four. All controls are located at the center of the machine for the convenience of the operator. The vibrating member is supported entirely on the surface of the concrete slab, and does not touch the side forms, thus eliminating the danger of settling or tipping the forms. The complete vibration unit is spring-suspended from the finishing machine, all of the vibration being absorbed by the concrete. The frequency and amplitude of vibration is adjustable over a wide range to suit varying concrete mixes and the vibrator attachment is furnished in any width required, and to operate below the top of the side forms if necessary.

With the first trip of the finishing machine, the concrete is struck off with the front screed and simultaneously vibrated down to the level of the top of the form. The pavement is then double-screeded in the conventional manner. One operator controls the entire vibrating and finishing process, with no delay in production.

Making One Truck Do the Work of Two

CONTRACTORS' service trucks and the trucks of state, county and city engineering departments are called upon to handle many types of jobs. Some organizations mount full-size portable air compressors upon them for mobility but this prevents the use of the trucks for other services. The Davey Compressor Co., Inc., Kent, Ohio, now offers a compressor of two-pavement-breaker or one-jack hammer capacity which can be mounted on any long wheel-base truck, taking its power from the truck motor. These truck-driven compressors occupy about one-fourth of the truck body space, leaving room for special bodies to carry men, tools and materials. Because of their air-cooled construction, they absorb about one-fourth the weight capacity of a 1½-ton truck, leaving enough carrying capacity for other purposes.

Loading One of the New Model C-55 Streamline International 3½ to 4½-Ton Trucks, Which is Powered by a Six-Cylinder Valve-in-Head Type International Engine

Keeping Construction Equipment Clean

A NEW product for cleaning oil and grease from metal, known as Magnusol, has recently been announced by the Magnus Chemical Co., 22 South Ave., Garwood, N. J. Magnusol is a scientifically prepared compound which readily makes all oils and greases easily rinsable with water. It is entirely safe to use, for both the worker and the article being cleaned.

For cleaning large equipment, such as automotive, road-building and other heavy machinery, one quart, or two pounds, of Magnusol No. 73 base should be mixed with one gallon of kerosene. This should be painted, preferably, or sprayed on the article to be cleaned and allowed to stand for several minutes to permit thorough penetration. It should then be removed by rinsing thoroughly with a pressure hose or stream of water. For cleaning small metal parts, a pint of the No. 73 base in a gallon of kerosene should be used, dipping the parts to be cleaned in the solution, allowing them to soak until the layer of dirt and grease is penetrated, and then rinsing them with cold water.

Magnusol No. 73 solvent, which is cleaning solution already mixed, is also available. A drum of either the No. 73 base or the solvent will be sent to any interested contractor on trial. If after using it, it does not prove entirely satisfacory, the unused material may be returned to the manufacturer with full credit, and with no loss to the user.

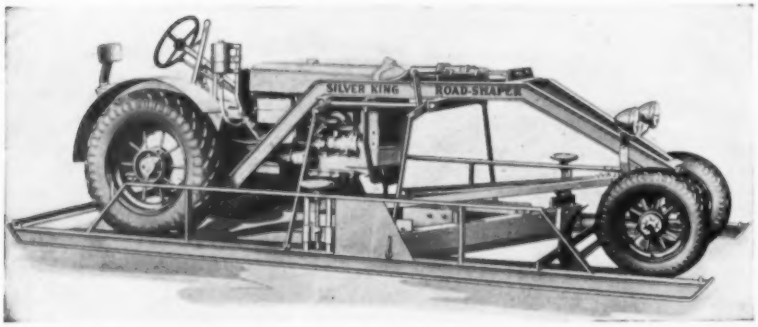
A Contractor's Truck Equipped with a Davey Compressor and Also Available for Other Uses

HERCULES
DIESEL ENGINES

● Simplicity . . . Compactness . . . Ruggedness . . . these are the heritage of Hercules Diesel Engines. Dependable, heavy-duty power for years has been characteristic of *all* Hercules Engine performance. Today, Hercules Diesel Engines are ably carrying on this Hercules Tradition.

HERCULES MOTORS CORPORATION, CANTON, OHIO, U. S. A.
MANUFACTURERS OF HEAVY-DUTY INTERNAL COMBUSTION ENGINES AND POWER UNITS
FROM 6 TO 200 HORSEPOWER

Please mention CONTRACTORS AND ENGINEERS MONTHLY—it helps.



The New Silver King Road Shaper Powered by a Silver King Tractor

No More Bumps in Grading

"HOW am I going to level off that athletic field, leaving it with absolutely no bumps?", wondered Contractor Smith as he gazed at the site of a grading contract. The answer to his question was found in the Silver King road shaper, made by the Fate-Root-Heath Co., Tractor Div., Plymouth, Ohio.

This road shaper is a new, simple and practical unit for leveling road surfaces, drives, berms, airports, athletic fields and similar surfaces. Designed by E. C. Gledhill, who has had over thirty years' experience in road building and the design and manufacture of road machinery, it is powered by a Silver King tractor, with four-speed transmission providing variable speeds for all types of road work. High gear is for transportation or traveling to and from the job, thus saving time and labor costs.

The unit has two blades, set at opposing angles, which shave off bumps and corrugations, mix and refine the material and deposit it in ruts and depressions. The material moves slowly along the front blade to a gate, then back along the rear blade, being pulverized and mixed in the process. As the shaper passes over ruts and depressions, they are filled by the surplus material. When the blades are properly adjusted, about 1/3 cubic yard of material is carried in front of the blades at all times. The only escape for the material is underneath the cutting edges, which prevents the formation of drifts or ridges when the road is worked. The blades have double edges and two sets of holes, making them reversible and giving double wear. The straight-edges along the two sides are 15 feet in length, rigid and sturdy, and each is provided with wearing shoes ½-inch thick, turned up at each end, and can easily be replaced when necessary.

The cutting edges are attached rigidly to the left-hand straight-edge but hinged at the center of the right-hand straight-edge. This permits the right-hand straight-edge to ride the uneven surface over which it travels, while forming a bridge to support the blades. Screw adjustments are provided to compensate for wear and to keep the blades cutting at the desired depth. Simple frame members of ample strength complete the working assembly.

The effective working width of the shaper is 7 feet. By use of a special apron attachment, the deposit of earth may be narrowed as desired in forming berms. The shaper is raised by hand hydraulic lift, and automatically lowered when in neutral position. The blades can be very quickly and easily raised and lowered while the machine is in motion.

Selecting a Proper Protective Welding Lens

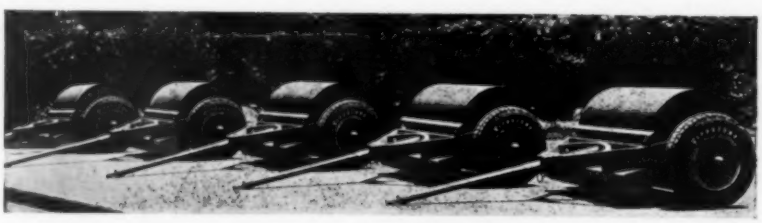
THE selection of a welding lens is a matter of personal safety. While the use of an inferior lens may give the user no immediate discomfort, prolonged use will prove harmful to the eyes and it is therefore vitally important that care be exercised in the choice of a proper lens.

The Super-Visibility protective lens, made by the Lincoln Electric Co., Cleveland, Ohio, is guaranteed to conform to the U. S. Bureau of Standards specifications, absorbing the objectionable rays and at the same time holding visibility at a point which permits a clear view of the work without tiring the eyes. This lens is made in two shades, according to the brightness of the arc—light or dark. Light A is for metallic arc welding and Dark B for carbon arc and heavy metallic arc work. The standard size of the lens is 2 x 4⅛ inches. Each lens is thoroughly inspected at the factory to insure accurate uniformity of thickness and to make certain that the glass is entirely free from waves or blemishes.

Electric Power for the Construction Job

FLICKERLESS current and modernistic streamline design feature the new 1935 Onan electric lighting plants, in 300, 500, 1,000 and 2,000-watt capacities, recently announced by D. W. Onan & Sons, Minneapolis, Minn. Each one of the new models is of unit construction with the generator mounted directly at the crankcase of the engine and provides flickerless alternating current, 110 volt, 60 cycle, which will operate any standard appliance that could be used on city line service up to the capacity of the machine.

The engines are 4-cycle, air-cooled, using 6-volt ignition, float-feed carburetor, mechanical governor, 6-volt starting motor and storage battery with remote control for self-starting. All parts are standard to the automotive and electrical field and available from any source where parts of this kind are supplied.

Other features of this new unit are pressure feed oiling through the crankshaft, aluminum pistons and connecting rods, dynamic balance engine, eliminating vibration. Each is provided with a socket base for rubber mounting for quiet operation. An extra silent muffler and flexible exhaust pipe are furnished.

These Wheeled Rollers Made by the Wheeled Roller Corp. of San Antonio, Texas, Are Easily Converted into Trailers for Easy Portability and Are Equipped with Firestone Heavy-Duty Tires